U. S. DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH SERVICE

ANIMAL AND POULTRY HUSBANDRY RESEARCH BRANCH

and

COOPERATING WESTERN STATES

W-1 - IMPROVEMENT OF BEEF CATTLE THROUGH THE APPLICATION OF BREEDING METHODS

1954 Annual Report of W-1

and

Report of

Annual Meeting of Technical Committee

Miles City, Montana

July 7 and 8, 1954

This report is intended for the use of administrative leaders and workers and is NOT for general publication.

ANNUAL MEETING
W-1 Technical Committee
Miles City, Montana
July 7 & 8, 1954

MINUTES

W-1 Technical Committee members present:

Arizona	O. F. Pahnish
California	P. W. Gregory
Colorado	H. H. Stonaker
Hawaii	Oliver Wayman
Idaho	C. F. Sierk
Montana	F. S. Willson
Nevada	J. F. Kidwell
New Mexico	Robt. Blackwell
Oregon	Ralph Bogart
U. S. Range Livestock Experiment Station, Miles City, Montana	J.R.Quesenberry
Utah	J. A. Bennett
Washington	W. M. Galgan
Wyoming	P. O. Stratton
Regional Administrative Adviser	S. S. Wheeler
Western Regional Coordinator	C. B. Roubicek
National Coordinator	R. T. Clark
Agricultural Research Service	O. E. Reed
	L. L. Madsen
Office of Experiment Stations	J. O. Grandstaff

University of Arizona

I. Station: Arizona Agricultural Experiment Station, Tucson, Arizona.

II. Title of Project: Breeding and Selection of Beef Cattle for the Southwest.

III. Personnel:

a. Experiment Station personnel
   (1) O. F. Pahnish
   (2) E. B. Stanley
   (3) C. E. Safley

b. Cooperators, Record of Performance Project
   (1) Frank S. Boice, (Empire Ranch), Sonoita, Arizona
   (2) Henry G. Boice, (Arivaca Ranch), Arivaca, Arizona
   (3) State experiment stations, western region

c. Cooperators, Dwarf Research Program
   (1) Purebred cattle breeders of Arizona and other western states
   (2) Personnel of other state experiment stations, western region

d. Coordinators (U. S. Department of Agriculture)
   (1) R. T. Clark
   (2) C. B. Roubicek

IV. Progress Since Last Annual Report: Record of Performance Program--The record of performance program (in cooperation with the Boice Brothers of Sonoita and Arivaca, Arizona) was continued along the lines described in previous annual reports. This program involves an evaluation of indexes used in culling the cow herds, in selecting female replacements, and in selecting herd bull replacements.

The data accumulated since the inception of this program in December of 1948 is contributing to an evaluation of variables encountered in beef cattle selection under southwestern range conditions.

A re-evaluation of feedlot performance techniques was undertaken during the past year. Digestibility studies involving the use of a modified lignin ratio were conducted in conjunction with the evaluation of these techniques. The feedlot records of 10 bulls were involved. The correlation of efficiency of feed utilization with rate of gain during an 180-day time-constant period and a condition-constant period, considered by the Arizona Station, indicated the following:

a. Daily gains and efficiency of feed utilization were quite highly correlated during both the 180-day time-constant period and the condition-constant period when an adjustment for differences in mean live weights was employed. This adjustment, a modification of the Winters and MacMahon formula[1] was as follows:

$$\text{Efficiency Quotient} = \frac{\text{Total Gain}}{\text{Total dry matter consumption}} \times \text{Mean live weight}$$

[1] Minn. Ag. Exp. Sta. Tech. Bull. 94, (1933).

The condition-constant period reduced the variation in mean live weights and resulted in a high correlation between gains and efficiency without the mathematical adjustment. (The condition-constant test was conducted within the time-constant test period. Thus, the same animals were involved in both cases. Condition was determined by visual appraisal.)

b. The condition-constant test emphasized the differences in finishing ability. Individual condition-constant periods varied from 84 to 138 days. Some individuals required condition-constant periods 28 to 42 days longer than did others when the initial condition scores, initial weights, and average daily gains were comparable.

DWARF[2] RESEARCH PROGRAM

The dwarf research program, initiated in 1948, was directed first toward a determination of the immediate cause of dwarfism in the Hereford breed, and later a study of the phenotypic expression of the dwarfism in newborn calves was undertaken. The second phase of the work was deemed important when it was found that dwarf characteristics are not always marked at birth or within one month thereafter. Because of the mild phenotypic expression of the dwarfism at early ages, heterozygous breeding stock might escape detection and progeny tests might be rendered useless if calf losses are encountered before the dwarf characteristics become pronounced.

A third phase of the dwarf research was directed toward an evaluation of the profilometer technique for the identification of heterozygotes in the horned Hereford population. A tabulation of profile classifications and breeding tests is maintained by the Arizona Station. In addition, the information is forwarded to the California Station where it may be included with the other data assembled by that Station. Initially, all profiles were classified by the California Station. The Arizona profiles are now classified by the Arizona Station.

The progress in dwarf research during the past year is indicated below:

a. A manuscript covering the inheritance of dwarfism and the phenotypic characteristics of Hereford dwarfs was prepared.

b. Measurements that may assist in the identification of the dwarf phenotype in newborn calves, as indicated by data now tabulated, are:

(1) Protrusion of the lower jaw
(2) Length of forecannon
(3) Length of rear cannon

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[2]Confined to the specific dwarfism described by: Johnson, L. E., G. S. Harshfield, and W. McCone. Dwarfism, an hereditary defect in beef cattle. Jour. Hered. 42:273, (1951).

c. Relative proportions that may assist in the identification of the dwarf phenotype in newborn calves are:

(1) Length of head/protrusion of lower jaw
(2) Length of forecannon/circumference of forecannon
(3) Depth of heart girth/length of forecannon

d. To date 210 profile tracings have been obtained from horned Hereford bulls. Thirty-two of the animals profiled have been proved by breeding tests.

Homozygous normals (10% probability level)	- 1
Homozygous normals (6% probability level or better)	- 8
Heterozygous	-23
Total	32

Data on all proven animals will be submitted to the California station for further consideration.

V. Summary of Progress and Conclusions to Date: Record of Performance Program--

a. Selection indexes now used in the performance program show greatest promise when used in conjunction with independent culling levels established for weights and scores. The indexes place equal emphasis on weaning weight, conformation score at weaning time, 18-month weight, and conformation score at 18 months of age. Scores are assigned by a committee of three judges. Since the performance program has been in progress, the breeding cows have been culled on the basis of their calf indexes; indexes have provided a basis for the selection of replacement heifers; a number of replacement sires have been selected on the basis of weaning indexes combined with subsequent indexes established by feedlot performance tests. Since the performance program was initiated in 1948, weaning weights corrected for age of calf, sex of calf, and age of dam, have been as follows:

1948 --- 418 lbs.
1949 --- 483
1951 --- 489
1952 --- 452
1953 --- 508
1954 --- 524

The introduction of range supplements probably contributed to the abrupt increase in average weaning weight in 1949. From that time forward, supplemental feeding practices were relatively uniform.

b. Limited evaluations of feedlot performance techniques indicated a relatively high correlation between rate of gain and efficiency of feed utilization when compensation for the differences in mean live weights was made. Marked differences in the finishing ability of bulls subjected to the feedlot performance test were noted.

Dwarf Research Program

a. A series of four breeding tests have indicated that the specific dwarf condition identified in section 4 of this report is produced by an autosomal recessive gene with complete penetrance. The gene has semi-lethal effect on the recessive homozygote.

(1) Ninety heterozygous x heterozygous matings produced 66 normal calves and 24 dwarfs. Adjusted chi square = 0.059.

(2) Five dwarf x dwarf matings produced dwarf calves only.

(3) Six heterozygous females were bred to dwarf males. Two normal calves and 4 dwarfs resulted. This phenotypic ratio may be expected about 23 percent of the time when 6 heterozygous x dwarf matings are involved.

(4) Seven cows of unknown genotype were bred to dwarf bulls. Four normal calves were produced. The three remaining calves were stillborn or died within two weeks after birth. The phenotypes of the latter three were not established beyond question. The need for positive methods of diagnosing the dwarf phenotype in newborn calves was emphasized.

b. The maximum ages obtained by dwarf males and females at the Arizona station were 58 and 61 months, respectively. One dwarf female attained the age indicated prior to death from undetermined causes. The dwarf bull was eliminated at 58 months of age as weakness in the hind quarters had rendered him incapable of natural service.

c. Measurements and relative proportions that may be of value in identifying dwarfism in newborn calves are listed in part 4 of this report.

d. General peculiarities noted in dwarf calves at birth or soon thereafter were:

(1) Protrusion of the eyes
(2) Continuous extension of the tongue
(3) Muscular weakness
(4) Incoordinated locomotion.

e. An excessive accumulation of fluid was found in the lateral ventricles of a few dwarf brains. This hydrocephalic condition was not present in all newborn dwarfs examined. Such a condition was found in one stillborn calf diagnosed as normal. The sire of the latter calf was subsequently proved free of the dwarf gene at the one percent probability level by a cooperating breeder.

VI. Work Plan for the Future:

a. Further evaluation of selection indexes.
b. Further evaluation of feedlot performance techniques.
c. Continuation of dwarf measurement studies to determine means of diagnosing the dwarf phenotype in newborn calves.
d. Further evaluation of the profilometer technique as a means of identifying Hereford bulls that are heterozygous for dwarfism.

II. Publications and Manuscripts:

Mountjoy, R. L., 1954. An evaluation of the different techniques for measuring the feedlot efficiency of beef cattle. University of Arizona Master's thesis.

Pahnish, O. F., C. E. Safley and E. B. Stanley. The inheritance and control of dwarfism in beef cattle. (In preparation).

Pahnish, O. F., E. B. Stanley and C. E. Safley. The inheritance and characteristics of a dwarf anomaly in beef cattle. (Manuscript in hands of station reviewing committee).

Safley, C. E., O. F. Pahnish and E. B. Stanley. A comparison of selection differentials for weight, gain in weight, and conformation score using different methods of selection. (In preparation).

Beef Breeding Project Summary

I. Inventory, record of performance program.

A. Empire Ranch

1. Breed - Hereford (Purebred - unregistered).
2. Bulls (12 mo. of age or over) ---------- 8
3. Cows (2 yrs. of age or over) ---------- 96
4. Heifers, yearlings ---------- 33
5. Male calves (est.) ---------- 37
6. Heifer calves (est.) ---------- 35
7. Estimated cash value ---------- $28,000

B. Arivaca Ranch

1. Breed - Hereford (Purebred - unregistered).
2. Bulls (12 mo. of age or over) ---------- 8
3. Cows (2 yrs. of age or over) ---------- 97
4. Heifers, yearlings ---------- 30
5. Male calves (est.) ---------- 35
6. Heifer calves (est.) ---------- 35
7. Estimated cash value ---------- $28,000

II. Inventory, dwarf research program

A. University of Arizona

1. Heterozygous cows ---------- 10
2. Dwarf bulls ---------- 3
3. Estimated cash value ---------- $ 1,800

III. Young animals on feed - 1953-54

A. Purebreds (Hereford)

	Individually Fed	Group Fed
Bulls	10	0
Heifers	0	0
Steers	0	0

IV. Additions of land, physical facilities and equipment during year 1953-54: None.

V. Funds expended during fiscal year 1953-54

Source	Amount Non-recurring items	Operating expenses
9b3		$2,500
BAI Funds		1,800
State Controlled Funds		3,300

Table I

Summary

Feed Lot Performance Test
Boice Bulls -- 1953-54
(Arizona Station)

	Test Period	
	Time Constant	Condition Constant[1]
BULLS ON TEST	10	10
LENGTH OF FEEDING PERIOD (days)	180	84-138
MEAN LIVE WEIGHT (lbs.)	911.00	914.40
Standard Deviation	104.67	54.02
Coefficient of Variation	11.49	5.91
AVERAGE DAILY GAIN (lbs.)	2.77	2.98
Standard Deviation	0.39	0.38
Coefficient of Variation	14.08	12.75
AV. FEED PER LB. GAIN[2] (lbs.)	13.13	12.68
Standard Deviation	0.76	1.62
Coefficient of Variation	5.79	12.78
AV. EFFICIENCY QUOTIENT[3]	134.70	139.54
Standard Deviation	11.23	15.52
Coefficient of Variation	8.34	11.12

[1]Condition determined by visual appraisal. Comparative condition scores assigned by committee of two judges.

[2]Ration contained 51.68 percent dry matter (lab. determination).

[3]Modification of Winters and MacMahon formula, Minn. Ag. Exp. Sta. Tech. Bulletin No. 94, (1933).

$$\text{E. Q.} = \frac{\text{Total Gain}}{\text{Total Dry Matter Consumption}} \times \text{Mean Live Wt.}$$

Table II

Correlations -- Efficiency and Rate of Gain[1]
Feed Lot Performance Test
Boice Bulls -- 1953-54
(Arizona Station)

Correlations	Time - Constant Period (180 days)		Condition - Constant Period	
	r	99% Limits	r	99% Limits
Feed per lb. gain and av. daily gain	-0.73	-0.96 to +0.05	-0.96	-0.99 to-0.73
Efficiency quotients[2] and av. daily gain	+0.92	+0.99 to +0.53	+0.95	+0.99 to+0.65

[1] For summary of data see Table I.

[2] Modified Winters and MacMahon formula. See Table I.

Table III

A Summary of Measurement Data on Normal and Dwarf Bull Calves

(Arizona Station)

	Mean		Range				Overlap Range		Measurements or ratios in overlap		Total calves involved	
	Normal	Dwarf	Normal		Dwarf				Normal	Dwarf	Normal	Dwarf
			From	To	From	To	From	To				
Ages and weights:												
Age weighed and measured (Hrs.)	40.2	36.8	12.0	72.0	Birth	80.0					24	9
Body wt. (lbs.)	75.5	65.7	59.0	87.0	49.0	76.0	59.0	76.0	11	8	24	9
Measurements:[1]												
Protrusion of lower jaw	0.5	1.2	0.2	1.1	0.6	1.6	0.6	1.1	4	3	16	8
Length of forecannon	14.7	12.6	13.3	16.0	12.2	13.0	None			None	15	6
Length of rear cannon	25.0	21.9	22.5	27.5	20.0	23.0	22.5	23.0	2	4	23	9
Ratios:												
Length of head/protrusion lower jaw	51.38	20.05	19.64	113.00	13.44	36.00	19.64	36.00	3	3	16	8
Length of fore cannon/$\frac{\text{circumference}}{\text{of forecannon}}$	1.34	1.08	1.26	1.47	1.01	1.15	None			None	15	6
Depth of heart girth/forecannon	1.83	1.98	1.66	1.94	1.91	2.10	1.91	1.94	2	2	15	4

[1] Measurements in centimeters.

Table IV

Profile Classifications vs. Breeding Test

Purebred, Horned Hereford Bulls Apparently Free of Dwarf Gene

(Arizona Station)

Profile No.	Age of Bull	Genotypic Classif.[1] Profile	Br. Test	Breeding Test Description
2*	41 mo.	H	N	Twelve normal calves from heterozygous cows. One calf stillborn. Eight normal calves from daughters of heterozygous bulls.
59	6 yrs.	N	N	Eight normal calves from heterozygous cows. Eighty-three normal calves from daughters of heterozygous bulls.
69	42 mo.	H	N	Four normal calves from heterozygous cows. Twelve normal calves from daughters of heterozygous bulls.
70	40 mo.	H	N	Seven normal calves from heterozygous cows. Forty normal calves from daughters of heterozygous bulls.
322	11 yrs.	H	N	Normal calves from thirty selected daughters of this bull when bred to known heterozygotes. One of above calves died of back injury.
346	36 mo.	N	N	Eight normal calves from heterozygous cows. No early calf losses or stillbirths.
413*	36 mo.	H	N	Twenty normal calves from heterozygous cows. No stillbirths or early death losses.
417*	51 mo.	H	N	Twenty normal calves from heterozygous cows. No stillbirths or early death losses.
421*	60 mo.	H	N	Twenty normal calves from heterozygous cows. No stillbirths or early death losses.

[1] H -- Heterozygous. N -- Homozygous normal.

* Profiles 2 and 421 taken from full brothers. Profiles 413 and 417 taken from paternal half brothers of the other two bulls.

University of California

I. Station: University of California (Project 1451), Davis, California.

II. Title of Project: "Genetic Control of Hereditary Deficiencies in Beef Cattle With Special Emphasis Upon Dwarfism".

III. Personnel: P. W. Gregory, F. D. Carroll, G. P. Lofgreen, L. M. Julian, W. S. Tyler, L. W. Holm, Dorothy S. Sprague, Lucy Kravetsky, and Don Toenjes.

IV. Progress Since Last Annual Report: Advances have been made along several fronts.

I - ANATOMY

A - Anatomical Collection (Dr. Julian's Report)

At this time some eighty-four specimens dealing with bovine dwarfism have been received and are being processed and catalogued by the Anatomy Department. Many of these specimens are in the form of intact embalmed carcasses or entire skeletons. The collection was started some three years ago and will continue in the years to come until a satisfactory number of specimens of dwarf, heterozygous and homozygous normal animals are accumulated. The collection will then exist and grow as a working museum of bovine anatomical materials.

B - Observations to Date

Since the technique of detection of heterozygous animals that has shown greatest promise involves the head, that portion of the animal should receive early detailed study. Since the dwarf exhibits extreme expression of dwarf conditioning genes, and any attempt to determine expression in the heterozygous state would probably involve features markedly involved in the dwarf state, the dwarf should receive the first intensive study.

As early as 1952 it was noted that some dwarfs had excessive volumes of cerebrospinal fluid which resulted in enlargement of the ventricles of the brain. Such intra-cranial accumulations of fluid might alter the contour of the bovine skull. Therefore, a program of routine determinations of the pressure of the cerebro-spinal fluid of all dwarf and heterozygous animals coming to the anatomical collection was initiated in December 1953. This study has not been sufficiently extensive to make a definite statement at this time; however, from the 17 animals that have been studied it is suggested that hydrocephalus is associated with dwarfism but may not always be manifest. These observations will be correlated with dissection studies.

In 1952 it was noted that the floor of the cranial cavity of the dwarf was shorter than normal. Also, it was noted that the nuchal surface of the skull formed a more obtuse angle with the long axis of the skull than was observed in normal skulls. These features may very well be interrelated; detailed study of these aspects will be initiated in the near future. Studies will include observations of the development of the paranasal sinuses. Alterations in the floor of the cranial cavity and in the development of the paranasal sinuses have been observed in various types of human dwarfs.

Preliminary observation of the nature of the frontal surface of bovine skulls indicates good agreement with observations developed by means of the profilometer. It would appear, therefore, that superficial soft tissues of the frontal area do not appreciably influence the profile pattern. These considerations will be studied in more detail in the coming year.

The long bones of the appendicular skeletons of dwarf and heterozygous animals are being measured. Proportional considerations and growth patterns of selected bones will be established. Growth patterns for bones of individual animals will be derived from serial radiograms now being collected. This information will be correlated with available information on dwarfism of other species.

II - GENETICS

Some progress has been made on the genetic relationships of the different morphological types of dwarfs. The following F_1 hybrids have been made:

1. Long headed Angus dwarf X conventional Hereford dwarf
2. Long headed Angus dwarf X Shorthorn dwarf (unlike any type yet reported)
3. Conventional Hereford dwarf X Shorthorn dwarf (same as in 2 above)

The F_1 hybrids from the above crosses are now being back crossed to their respective parental types and other morphological types of dwarfs.

V. Summary of Progress and Conclusions to Date:

A - An extensive series of new data on mature horned Hereford have been collected from the field since the publication of the Hilgardia article. These data are in good agreement with the original sample collected and support our earlier conclusions. We have profiled many unproven bulls which definitely manifested carrier type of profiles that the owners assumed were dwarf-free. The reports from progeny tests that have come to us have shown an agreement between the progeny tests and the profile type.

B - Dwarf-carriers and dwarf-free horned Hereford bulls from 12 to 17 months of age can be consistently separated by means of the profilometer technique. It may be some time befcre the full extent of the over-lap is determined.

VI. Work Plan for the Future: The work of the future will be along the lines done in the past with emphasis upon Genetics, Anatomy and Physiology, with an attempt to integrate as completely as possible all of these different types of investigations. The specific studies planned are as follows:

GENETICS

1. Study the inheritance of each specific dwarf conditioning gene.
2. Study in detail the characteristics in living animals of each recessive genotype as compared with homozygous normals.
3. Study in detail the characteristics in living animals each specific heterozygous genotype and search for evidence of heterozygous expression. These studies will be integrated with those of

anatomy, histology, and physiology in an effort to make up a "pedigree of causes" for each specific mutant gene.

4. To determine insofar as possible the effect of each specific dwarf conditioning gene or various combinations of dwarf conditioning genes upon current practices in the selection of breeding stock.

5. To determine insofar as possible the genetic relationships of the several dwarf conditioning genes. These studies may be combined with other genes since the herd is also being used in blood antigen studies.

6. Estimations of the frequency of each specific dwarf conditioning gene in the various breeds.

ANATOMY

The general objective is to determine the expression of each specific dwarf conditioning gene in both the recessive and heterozygous genotypes, upon specific anatomical and physiological characteristics. All of the anatomical studies will be done by the Department of Anatomy School of Veterinary Medicine of the University of California. Both the Animal Husbandry and Veterinary Departments will participate in the physiological investigations. The experimental dwarf herd maintained by the Department of Animal Husbandry will provide the material.

I. Osteology

A. Descriptive anatomy of the skull and axial skeleton of dwarf, heterozygous and homozygous normal animals as related to age and sex.

1. Superficial characteristics of the skulls of the three genotypes of animals.

2. The volume of the cranial cavities of bovine skull of all genotypes.

3. The volumes of paranasal sinuses of bovine skull of all genotypes.

4. Age changes in the superficial structure of bovine skull of all genotypes.

5. The characteristics of the vertebrae of animals of all three genotypes.

B. Descriptive anatomy of the appendicular skeletons of dwarf, heterozygous and normal animals as related to age and sex.

1. Specific measurements of the bones of the appendicular skeleton and proportional consideration of these measurements in reference to body weight.

2. Tabulation of the ossification points in bones of the appendages of the three genotypes of animals.

C. Growth Studies

1. The development of the paranasal sinuses in normal, dwarf and heterozygous animals.

2. Times of closure of sutures and ossification points in the skulls and vertebral columns of the three genotypes.

3. Establishment of times of closure of the points of ossofication of appendicular skeletons of the three genotypes.

4. Study, by means of serial radiograms, the skull and vertebral columns of dwarf heterozygous and homozygous normal animals in reference to growth.

5. Studies on bone growth with the use of vital stains.

II. Central Nervous System

1. The weight of the brains of bovine animals in reference to body weight and degree of expression of dwarf genes.

2. Volume of ventricles of bovine brains.

3. The terminative of the spinal cord and meninges of the bovine in reference to age and genotype and in reference to osseous characteristics of the vertebral column.

III. Splanchnology

1. Descriptive anatomy of the structures of the thoracic and abdominal cavities.

2. Weights and volumes of specific structures of the abdominal cavity.

3. The distribution of the autonomic nervous system.

IV. Superficial Anatomy

1. The structures of the frontal region and their development in animals of the three genotypes.

2. The development of connective tissue structures with age, median raphe' periosteumon facia, etc.

V. Lymphatic System

1. The development of specific lymphatic structures with age.
2. The weight of the thymus in reference to the weight of other tissues, age, and total body weight.

VI. Cerebro-Spinal Fluid

1. The pressure of cerebro-spinal fluid in animals of the three genotypes.

2. The rate of formation of cerebro-spinal fluid in the normal bovine.

3. The mechanism and rate of absorption of cerebro spinal fluid in the bovine.

VII. The Vascular System

1. The vascular system in relation to growth of paranasal sinuses.

2. The venous drainage from the skull and axial skeleton of the bovine in reference to the absorptive of cerebro-spinal fluid.

3. The vascular system of specific organs of the three genotypes.

4. The vascular systems of the endocrine glands.

VIII. The Endocrine System

1. Weights of thyroid, pituitary, adrenals of animals of the three genotypes.

2. Microscopic anatomy of the endocrine glands.

IX. Experimental Anatomy

1. A systematic study of experimental bovine cretins, encompassing above points and comparison of the structure of thyroid-ectomized animals with anatomical expression of hereditary dwarfism.

PHYSIOLOGY AND BIOCHEMISTRY

1. Protein-bound iodine (P.B.I.) determinations on the blood of dwarfs, heterozygous and homozygous normals.

2. Rate of I^{131} uptake by the thyroid in the three genotypes.

3. Sodium and potassium concentration of the blood in the three genotypes as a reflection of adrenal function.

4. Assay of anterior pituitaries from the three genotypes for growth hormone.

5. Blood glucose determinations as an indication of pituitary, adrenal or pancreatic function.

6. Nitrogen balance studies as an indication of protein assimilation and use.

7. Calcium and phosphorous determinations in blood and feces of all three genotypes. This will give an indication of assimilation and parathyroid function.

8. Comparative feed utilization of dwarf-carrier and dwarf-free animals.

9. Complete haematology analysis of all three genotypes.

10. Various aspects of carbohydrate metabolism, glucose and galactose tolerances as well as insulin sensitivity will be investigated.

11. Determination of functional level of pituitary-adrenal axis by means of ACTH injections and blood and urine assays of adrenal steroids will be made.

12. Gonadotrophic and estrogen assays will be made.

VII. Publications and Manuscripts

Carroll, F. D., P. W. Gregory, and W. C. Rollins. 1951. Thyrotropic Hormone Deficiency in Homozygous Dwarf Beef Cattle. Journal of Animal Science, 10:916-921.

Gregory, P. W., W. C. Rollins, P. S. Pattengale and F. D. Carroll. 1951. A Phynotypic Expression of Homozygous Dwarfism in Beef Cattle. Journal of Animal Science, 10:922-933.

Gregory, P. W., S. W. Mead, W. M. Regan and W. C. Rollins. 1951. Further Studies Regarding Sex-Limited Genetic Infertility in Cattle. Journal of Dairy Science, 34:1047-1055.

Gregory, P. W., S. W. Mead and W. M. Regan. 1951. A Genetic Analysis of Prolonged Gestation in Cattle. Portugaliae Acta Biologica Series A - R. B. Goldschmidt. Volume 861-882.

Gregory, P. W., W. C. Rollins and F. D. Carroll. 1952. Heterozygous Expression of the Dwarf Gene in Beef Cattle. Southwestern Veterinarian, V, (4) 345-349.

Gregory, P. W., and B. B. Brown. 1952. A Profilometer for Studying Head Form of the Bovine. Journal of Animal Science, 11:(4).

Gregory, P. W., F. D. Carroll, C. B. Roubicek, P. O. Stratton, N. W. Hilston. 1953. Inheritance of Dwarfism in Herefords and the Detection of Heterozygotes. Hilgardia. 22:407-450.

Gregory, P. W., C. B. Roubicek, F. D. Carroll, P. O. Stratton, N. W. Hilston. The Separation of Dwarf-Carrier and Dwarf-Free Genotypes in Horned Hereford Bulls From 11 Months and Upwards by the Profile Method. (Manuscript in preparation).

Gregory, P. W., F. D. Carroll, Reuben Albaugh. Dwarfism in Beef Cattle and Its Control. (Manuscript in preparation).

Ware, W. S. 1952. Evidence for the Expression of the Dwarf Gene in Heterozygous Bulls. University of California, Doctors thesis.

Animal Inventory

Experimental Dwarf Herd

	Herd Bulls	Cows	Yearling Heifers	Yearling Bulls
Hereford (Dwarf)	1	12	8	0
Hereford (Heterozygous for Dwarfism)	2	18	8	0
Shorthorn (Dwarf)	2	3	0	0
Angus (Dwarf)	3	3	2	2
Hybrids from Dwarfs (Hereford-Angus)	2	0	4	0
Hybrids from Dwarfs (Hereford-Shorthorn)	0	2		0
Others	0	0	10	6

California

I. Station: Agricultural Experiment Station, Davis, California.

II. Technical Personnel: W. C. Rollins (Project leader), F. D. Carroll, K. C. Green, P. W. Gregory, N. R. Ittner, and K. A. Wagnon.

III. Title of Project: Breeding Experiments With Beef Cattle.

IV. Object:

1. To investigate methods of selecting bulls for the transmission of improved rate of gain, economy of gain, earliness of maturity and carcass characteristics.

2. To investigate methods of selecting cows to improve productivity and reproductive fitness.

3. To investigate the value of crossbreeding a nd environmental controls in improving the adaptability of beef cattle to the summer conditions of high temperature and humidity in the Imperial Valley.

V. Work in Progress: Testing bulls directly and by use of progeny for rate of gain, efficiency of gain and earliness of maturity.

All bull calves are individually feed lot tested following a 4 to 6 month post-weaning period during which time they are on a growing ration consisting mainly of roughage. Rate and efficiency of gain in the feed lot will be correlated with rate of gain in the preceding post-weaning period. If such a correlation proves high enough it would greatly simplify the testing of bulls on an intra herd basis.

While in the feed lot the slaughter condition of each bull at the start of the test and every 28 days thereafter is estimated to afford evidence on earliness of maturity and to enable comparisons of rate of gain and efficiency of gain for similar periods of growth and fattening.

Six bulls are being progeny tested each year. A get of 10 steers from each bull will be tested for rate of gain and earliness of maturity in the same manner as indicated for the bulls except that they will be group fed by sire lots in the feed lot.

Body measurements are taken of bulls and steers at the start and finish of the feeding period. In the case of the steers these measurements will be studied in relation to carcass data.

The reliability of protein bound iodine as an indicator of feed utilization is being studied. In this connection, blood samples are taken at the start and finish of the feed lot period on all bulls and steers.

Breeding Yearling Heifers

Starting with the breeding season of 1953, heifers have been bred as yearlings. Through eliminating a year of the non-productive period, it has been possible to delay culling of heifers until a partial record has

been obtained. Calves from these heifers are weaned at 3 to 4 months of age instead of the customary 8 months. The value of this partial record as an indicator of lifetime production will be investigated. Birth weights and monthly weights to weaning are recorded.

Growth During the Suckling Period

The collection of birth weight, monthly weights to w eaning and body measurements at weaning is being continued for further analysis of factors affecting growth during this period.

Adaptation of Beef Cattle to the Summer Conditions of High Temperature and Humidity in the Imperial Valley

In 1953 an experiment got underway to explore the possibility of adequately maintaining a beef breeding herd under Imperial Valley conditions. Twenty head of grade Hereford heifers, twenty head of Braford heifers and a polled Hereford bull were purchased.

Each year all of the cows will be bred to the Hereford bull, thus producing Hereford and 3/4 Hereford:1/4 Brahma calves. The experiment is to run for six year.

Calves will be weaned at 8 months, be on grass for about 6 months and will be slaughtered around 18 months of age after about a 90-day period in the feed lot. Carcass data will be obtained. Other data being obtained are (1) birth weight and monthly weights on all animals, (2) rectal temperatures of the calves during the period of summer stress, (3) body measurements on calves at weaning and at conclusion of the feed lot period.

Lifetime performance of the cows will be studied, including consideration of productivity, reproductive fitness and morbidity.

Growth rate, efficiency of gain, health and carcass characteristics of the calves will be correlated with body temperature and breed.

VI. Results: Hereford and Braford steers and heifers compared for rate and efficiency of gain in the feed lot, dressing percentage and various carcass characteristics.

At the Imperial Valley Field Station 6 Hereford steers, 6 Hereford heifers, 6 Braford steers and 6 Braford heifers were group fed in the feed lot from 10/8/48 to 5/1/49 (205 days). Under similar conditions 8 Hereford steers, 8 Hereford heifers, 8 Braford steers and 8 Braford heifers were fed from 10/14/49 to 4/29/50 (197 days).

Rate of gain was the same for each year. The combined results of the two years follows:

	Herefords	Brafords
Number of animals	28	28
Average initial weight	496	494
Average daily gain	2.16	1.90
Feed per 100 lbs. gain		
Grain	282	307
Dry beet pulp	173	187

	Herefords	Brafords
Feed per 100 lbs. gain (continued)		
Alfalfa hay	293	325
Sudan and barley hay	68	77
Beet top silage	27	33

The Herefords gained .26 lb. per day more than the Brafords, a highly significant difference with 95 percent confidence limits of .14 and .38.

The Herefords required less feed per 100 lbs. gain than did the Brafords.

The Hereford carcasses graded higher on the average than the Braford carcasses. Of the Hereford carcasses, 12 percent were choice, 84 percent good and 4 percent commercial. Of the Braford carcasses, 71 percent were good, 25 percent commercial and 4 percent utility.

The Brafords dressed 62.6 percent and the Herefords 60.4 percent (Hot carcass wt.). This difference of 2.2 percent is highly significant statistically.

Based on the analysis of the 11th and 12th rib cut, the Braford carcasses contained 2.1 percent more bone than the Hereford carcasses. This difference is highly significant statistically.

Breed differences were analyzed for the following measures of carcass conformation: Percent of forequarter, percent of sirloin tip and loin, percent of round, percent of flank, percent of rib, percent of briskit and shank, percent of plate and percent of chuck. A significant breed difference was found only for percent of flank. This was .5 percent higher in Herefords.

VII. Animal Inventory:

Location	Breed	One year and older			Calves		
		Females	Bulls	Steers	Females	Bulls	Steers
Davis	Hereford	61	31	4	16	13	1
	Angus		7				
	Crossbred				5		2
San Joaquin Exp. Range	Grade Herefords	192		25	95	Steers and Heifers	
Imperial Valley	Polled Hereford		1				
	Grade Herefords	20			6		7
	Brafords	28					
	3/4 Hereford 1/4 Brahman				4		6
	Hereford x Brahman x Charollais				5		1

VIII. Facilities: Same as previously reported.

IX. Manuscripts:

Rollins, W. C., and H. R. Guilbert. 1954. Factors Affecting the Growth of Beef Calves During the Suckling Period. Journal of Animal Science, 13: 517-527.

ITTNER, N. R., H. R. Guilbert and F. D. Carroll. The Adaptation of Dairy and Beef Cattle to Hot Desert Areas. California Experiment Station Bulletin in press.

Discussion by Technical Committee:

Professor Willson commented on the scope of the revised California dwarf research program. Dr. Gregory pointed out that the Veterinary Science Division and the Stanford Medical School are now actively participating in the project. He also stated that the material at California is available to any interested institution provided he has sufficient technical help to collect the necessary samples.

Colorado

I. Station: Colorado Agricultural Experiment Station, Fort Collins, Colorado.

II. Title of Project: R & M 26, Improvement of Beef Cattle Through Breeding. A Study of Inbreeding and the Crossing of Inbred Lines Within the Hereford Breed.

III. Personnel: H. H. Stonaker, Kent Riddle, F. C. Daugherty, three graduate assistants.

IV. Studies in Progress Since Last Annual Report:

A. Profilometer Study

Profiles of herd bulls in the Ft. Lewis lines and on the bulls of cooperating breeders predict 70% to 80% to be carriers. Genotypic predictions on unselected 13-month old sons of bulls profiling +d and ++ using Dr. Gregory's discriminant function ($1.57X_1 + X_2$) indicate genetic ratios of 9 ++ : 53 +d : 1 dd, or 14% ++, 84% +d, 2% dd genotypes. Predictions were made eliminating Class I and polled heads and the overlap group with readings of 5 to 8. Readings under 5 were interpreted to be ++, those over 8 were considered as +d, one dwarf bull calf in the same calf crop was included as dd. The weighted gene frequency of d in the sire herd was calculated as .42 on the basis of profiles. Assuming the cow herd to be completely heterozygous or having dwarf gene frequency of .5 would give an expected genetic ratio in the sons of 18 ++ : 32 +d : 13 dd. A highly significant X^2 of 29 indicates that even with every cow assumed to be heterozygous it would not be expected to obtain so few ++ and dd and so many +d sons. These data indicate that the profilometer predictions deviate greatly and significantly from any feasible ratio of genotypes that could be expected in a breeding herd.

B. Tester Matings

Royal 0144 a 41% inbred bull in the Royal Line which has not produced any dwarfs in the Fort Lewis herd was mated with tester cows in the herd of Henry Bledsoe, Wray, Colorado. This bull which profiled carrier and was predicted on the basis of his line's performance and progeny record to be clean sired two dwarf calves in the Bledsoe herd. Another herd sire, Prospector 300, a line in which it is now established there is dwarfism, due to the fact that one calf suspected to be a dwarf was born in 1953 and two definite dwarfs out of 7 calves were born in 1954 in this inbred line. This bull which had sired a suspicious calf in the Experimental herd sired no dwarfs in the test herd on the Conrad ranch. This bull produced six calves out of known dwarf-carrier cows and ten calves from daughters of known carrier bulls.

C. Blood Antigen Studies

Blood antigen studies were continued again in 1953. Analyses were in progress on antigen loss as associated with inbreeding.

D. Field Tests of Inbred Bulls

Individual weights are available on the comparison of top cross calves sired by inbred bulls from the Fort Lewis lines with representative commercial cattle in the feed lots of Kenneth Conrad Ranch, Wray, Colorado, and Louis Bein, Berthoud, Colorado. It is hoped that fairly conclusive weaning performance records can be taken on the Conrad Ranch this year since the progeny of approximately eight inbred bulls from Fort Lewis lines have been calves on that ranch this year. It will be possible to compare these calves with a progeny of a number of representative range bulls. It appears that there may be an opportunity to follow these cattle through the feed lots.

E. Fertility as Associated with Age

Approximately 4,000 records on the association between age of dam and sires and fertility have been analyzed from Wyoming Hereford Ranch data by Mr. L. R. Burke. Cows have peak fertility at 4 to 7 years. Bulls under six brought about the highest fertility.

F. Performance of Inbred and Topincross Herefords

A three-year summary of cows' and bulls' performance of inbreds and topincross Herefords indicates an 18 percent advantage for the topincross in calving percent, a 9 percent advantage in weaning weight, and a 29 percent advantage in pounds of calf per hundred cows bred. Comparison of bull performance of inbreds and topincross bulls showed about a 5 percent advantage for the topincross over the inbred in daily gain, a 3 percent disadvantage in efficiency, a 14 percent advantage in yearling grade and an 8 percent advantage in final weight. It is thought that the low efficiency of the crosses relative to the inbreds may be due to the fact that the crosses are heavier when they start the experiment.

G. Correlations Between Thickness of Fat Over the Longissmus Dorsi in Fat Steers and Judges Grades Vs. Correlation Between Fat Thickness and Electrical Resistance.

The correlation on 55 steers between judges' market grades and the thickness of fatness over the longissmus dorsi is approximately .20. The correlation between the electrical resistance in the live animal body measured by the use of electrodes connected through a Wheatstone bridge and the thickness of fat over the longissmus dorsi was of the nature of -.10 to -.13. Thus, it appears that neither of these methods offer much promise so far as rapidly predicting variations in the degree of individual fatness in lots of cattle which are about ready for market.

H. Statistical Analysis of Four Years of Individual Feeding of Purebred Hereford Steers

Through the use of IBM equipment, covariance studies for all combinations of approximately 70 observations on 140 steers individually fed to a constant degree of fatness have been prepared. It is hoped that a number of studies on genetic correlations and heritabilities of traits not yet studied may be developed from these data.

V. Work Planned for Next Year: It is planned to continue present studies and to begin individual feeding of steers for the purpose of testing the performance of topincross steers vs. representative range steers bred on the same ranch and raised under the same conditions. It is planned to feed these steers to a fat constant finish and it is hoped that several different measures for determining objectively condition in the live animal body may be investigated.

VI. Manuscripts and Publications:

Burgess, J. B., Nellie L. Landblom, and H. H. Stonaker. 1954. Weaning Weights of Hereford Calves as Affected by Inbreeding, Sex, and Age. Journal of Animal Science. (In press).

Burke, L. R. 1954. Age as a Factor Influencing Calving Percentage in a Hereford Herd. (M.S. Thesis).

Stonaker, H. H. 1954. 1954 Report on The Colorado Experimental Beef Breeding Program, Colorado Agricultural Experiment Station, General Series Paper 580.

Stonaker, H. H. 1954. Dwarfism in Beef Cattle. Western Section American Society of Animal Production, Corvallis, Oregon.

VII. Animal Inventory and Use in 1954

Hereford Lines	Location	Bulls	Cows and Yearling Heifers being bred within lines	Line crosses and topincrosses
Bonanza	Ft. Lewis	1	8	15
Brae Arden	" "	1	11	12
Colorado	" "	1	11	11
Don	" "	1	8	14
Ft. Lewis	" "	1	12	9
La Plata	" "	1	13	7
Mesa	" "	1	10	10
Monarch	" "	1	12	12
Prospector	" "	1	8	13
Royal *	" "	1	0	
San Juan	" "	0	0	
Verde	" "	1	9	11
Plus	Cooperator	1	7	(15)
Real Prince	"	1	7	(15)
Elector	"	1	8	
Model Domino	"	1	6	
		15	130	114

Total calves at Ft. Lewis	157
Total cows and yearlings	244
Herd bulls	15
Bulls individually fed 1954	80

*F_1 Test crosses in 1954
( ) Owned by cooperator

/signed/ H. H. Stonaker
H. H. Stonaker
June 24, 1954

Discussion by Technical Committee:

Dr. Stonaker explained that in the profile studies at Ft. Lewis the comprest bulls and sons of comprest bulls were not included. One line which has comprest background but has not shown comprest type is now producing dwarfs. There are few, if any, bulls in the Ft. Lewis profile study out of comprest cows. Dr. Roubicek stated that the discriminant function used in classifying the Ft. Lewis progeny bulls was computed for mature animals and its value for young animals had not been established. He also pointed out that although the progeny groups were unselected, they were not complete, since no record was made of calf losses. Although the progeny groups are small, an analysis by Dr. Shelby indicates there is a statistically significant difference in the "X" values between sire groups. Profile comparisons within sire groups do show a definite pattern.

Dr. Sierk indicated that many people, including some in industry, have been waiting for the Ft. Lewis tests before deciding if the profilometer is a useful tool. He wondered if the group wanted to go on record in regard to the use of the profilometer. He felt that discarding the profilometer at this time would be interpreted by many in industry that the problem of dwarfism was not as serious as previously indicated. He suggested the need for additional clarification so that station workers would be able to competently answer questions put to them. Dr. Stonaker stated that they would not care to assume the responsibility of establishing the accuracy of the profilometer at Ft. Lewis and suggested that all stations in the Western Region accumulate data on their herds and then pool these data for a more complete study.

Prof. Pahnish asked what the age limits were for the discriminant function $1.57X_1 + X_2$. Dr. Gregory replied that it was applicable to mature head profiles. He considered that 24 months of age would certainly be sufficient and it would probably be applicable at 20 months of age. He also stated that a theoretical function was being used for bulls in the 12- to 17-month age group.

Hawaii

I. Station: Hawaii Agricultural Experiment Station, Honolulu, Hawaii.

II. Title of Project: The Improvement of Beef Cattle Through Breeding - Unsupplemental Pasture Performance Studies.

III. Personnel: Oliver Wayman, L. A. Henke and H. J. Weeth, of the Hawaii Station, and A. Hartwell Carter, Edwin Johnston, A. M. Brown, Roger T. Williams, Fred C. Schattauer, and Allan Johnston, of the cooperating ranches, plus the operating staffs of the ranches.

IV. Progress Since Last Report: Weights and grades have been recorded at weaning and one year of age on the first crop of calves. These have all been adjusted to a common age basis of 240 and 365 days. These data show responses much below the normal because of the extreme drought of the past year. In some instances, the drought had been relieved by the time yearling data were collected. (See attached summary.)

V. Summary of Progress and Conclusions to Date: The differences in response shown by the offspring of various sires under the same environmental conditions indicate that progeny testing can be definitive at sub-maintenance levels of nutrition.

Environmental differences among cooperators are too great to permit pooling of data until means are available to measure the differences.

VI. Work Plan for the Future:

a. Continue program at present organized.
b. Attempt to collect weights on cows pre-parturition and on weaning time as a measure of dam influence on calf weight at weaning, and ranging ability of the dam.
c. Work out correction factors for influence of age of dam on weaning weight under local conditions.
d. Transfer data to IBM cards.

VII. Publications and Manuscripts: None.

PROGENY TEST RESULT 1953-1954

Cooperator	PARKER RANCH							
Sire	Supreme Lamplighter A0-		Royal Domino 122 A0+		Colorado Aster A1+		Foley Farms Advanced Lamplighter A3-	
	♂	♀	♂	♀	♂	♀	♂	♀
Weaned Calves:								
Number	6	7	1		2		5	5
Av. adjusted 240-day weight	571 ± 49.5	462 ± 36.2	350		490		557 ± 61	446 ± 91
Average daily gain	2.09 ± 0.21	1.63 ± 0.15	1.17		1.75		2.03 ± .32	1.57 ± .38
Average grade	6.2 ± 1.5	6.4 ± .8	4.0		5.0		6.6 ± .6	5.0 ± 1.9
Average dam grade	6.0	6.3	-		-		5.3	5.3
Yearling Calves								
Number	4	7	1		1		4	5
Av. adjusted 365-day weight	702 ± 37	560 ± 17	500		710		744 ± 35	528 ± 54
Average daily gain	1.73 ± 0.15	1.34 ± .05	1.18		1.75		1.81 ± .10	1.25 ± .15
Average grade								

	KAHUA RANCH				KAPAPALA RANCH			
	LesKan Tone 6th B0		LesKan Tone 4th BK		E 1		E 2	
	♂	♀	♂	♀	♂	♀	♂	♀
Weaned Calves:								
Number	19	20	17	22	13	8	7	12
Av. adjusted 240-day weight	412 ± 73	378 ± 53	395 ± 65	365 ± 57	362 ± 50	347 ± 44	354 ± 53	352 ± 32
Average daily gain	1.43 ± 0.31	1.28 ± .24	1.35 ± 0.27	1.23 ± 0.23	1.22 ± .22	1.16 ± .18	1.18 ± .22	1.17 ± .13
Grade	5.7 ± 1.6	5.8 ± 1.6	5.8 ± 2.0	5.6 ± 2.0	5.2 ± .9	5.9 ± 1.2	4.9 ± 2.2	5.4 ± 1.4
Average dam grade	5.3	5.3	6.2	5.7	4.2	4.5	4.1	4.4
Yearling Calves:								
Number	11	15	13	16	12	8	9	14
Av. adjusted 365-day weight	475 ± 52	441 ± 40	460 ± 48	430 ± 27	370 ± 30	348 ± 29	342 ± 45	341 ± 37
Average daily gain	1.11 ± 0.14	1.02 ± .09	1.07 ± 0.13	0.99 ± 0.09	0.82 ± .08	0.76 ± .08	0.74 ± .12	0.74 ± .10
Grade	3.2 ± 1.5	4.0 ± 1.7	3.8 ± 1.9	4.2 ± 1.2	4.9 ± 1.4	4.7 ± .7	4.0 ± 1.5	6.3 ± 1.8

Cooperator	KUKAIAU RANCH							
Sire	Domestic Woodrow CO		Domestic Mischief CM		Doctor Clark CT		Joe Correia CJ	
	♂	♀	♂	♀	♂	♀	♂	♀
Weaned Calves:								
Number	11	14	13	11	11	12	17	17
Av. adjusted 240-day weight	472 ± 39	392 ± 50	434 ± 67	420 ± 40	360 ± 40	367 ± 32	388 ± 29	368 ± 31
Average daily gain	1.68 ± .16	1.34 ± .21	1.52 ± .28	1.46 ± .17	1.21 ± .17	1.24 ± .13	1.33 ± .12	1.24 ± .13
Grade	5.9 ± 1.1	5.8 ± 1.3	6.4 ± 1.0	6.4 ± 1.2	5.6 ± .9	5.8 ± 1.3	5.2 ± 1.7	5.8 ± 1.1
Average dam grade	4.6	5.4	4.5	4.0	4.5	4.7	3.2	4.4
Yearling Calves:								
Number	11	11	13	11	6	10	17	16
Av. adjusted 365-day weight	471 ± 33	409 ± 36	421 ± 59	408 ± 39	372 ± 27	372 ± 48	423 ± 35	395 ± 29
Average daily gain	1.10 ± .09	0.93 ± .10	0.96 ± .38	0.93 ± .11	0.83 ± .07	0.83 ± .13	0.97 ± .10	0.89 ± .09
Grade	4.6 ± 1.0	5.0 ± 1.1	4.4 ± 2.0	4.5 ± 1.6	2.5 ± 1.4	3.1 ± 1.2	3.3 ± .9	3.4 ± .9

	KAALUALU RANCH							
	D 1		D 2		D 3		D 4	
	♂	♀	♂	♀	♂	♀	♂	♀
Weaned Calves:								
Number	5	3	2	7	7	7	7	
Av. adjusted 240-day weight	301 ± 73	260 ± 92	287	249 ± 53	354 ± 41	310 ± 52	258 ± 38	
Average daily gain	0.96 ± .69	0.79 ± .38	0.91	0.75 ± .22	1.18 ± .17	1.00 ± .22	0.78 ± .16	
Average grade	3.8 ± 1.5	3.3 ± 3.2	4.0	2.9 ± 1.2	4.7 ± .9	5.6 ± .8	3.6 ± 1.8	
Average dam grade	3.3	4.3	3.0	3.3	3.2	3.6	2.3	
Yearling Calves:								
Number	4	3	2	6	5	7	6	
Av. adjusted 365-day weight	536 ± 56	357 ± 114	531	329 ± 41	573 ± 27	387 ± 69	496 ± 49	
Average daily gain	1.29 ± .13	0.79 ± .32	1.26	0.71 ± .10	1.38 ± .07	0.87 ± .19	1.17 ± .13	
Average grade	5.0 ± 1.2	4.0 ± 2.0	5.0	4.3 ± 1.2	5.6 ± .6	5.1 ± 1.6	4.8 ± 1.5	

I. Cattle Inventory
A. Purebreds

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

State HAWAII
Date June 1954

Line designation	A0-	A0+	A1+	A3-	A3+	A4-	A5-	B0	BK
Breed	Polled Hereford	Hereford	Hereford	Polled Hereford	Hereford	Polled Hereford	Polled Hereford	Polled Hereford	Polled Hereford
Station	Parker	Parker	Parker	Parker	Parker	Parker	Parker	Kahua	Kahua
Bulls (12 mo. or over)	6	1	4	6	1	1	1	20	19
Cows (2 yrs. or over)	18	18	18	18	18	18	18	48	45
Heifers, yearlings	13	1	2	5				22	21
Male calves	4	3	3	7	12	8		22	22
Heifer calves	1		4	9	4	5	1	20	14
Percentage for Breeding project	95	85	87	90	85	70	65	100	100
Estimated cash value	11,500	7,400	9,700	12,500	9,500	19,700	12,000	24,825	23,275

B. Grades

Line designation	C0	CM	CT*	CJ*	D1	D2	D3	D4	E1	E2
Breed	Polled Hereford	Polled Hereford	Polled Hereford	Polled Hereford	Hereford	Hereford	Hereford	Hereford	Hereford	Hereford
Station	Kukaiau	Kukaiau	Kukaiau	Kukaiau	Kaalualu	Kaalualu	Kaalualu	Kaalualu	Kaalualu	Kapapala
Bulls (12 mo. or over)	12	14	7	18	5	3	6	7	1	1
Cows (2 yrs. or over)	34	41	47	55	20	20	20	20	24	24
Heifers, yearlings	14	11	10	16	3	6	7	5	8	14
Male calves	2	8	17	22	6	8	9	8	6	8
Heifer calves	13	15	18	26	8	7	6	8	8	7
Percentage use for breeding project	100	100	100	100	100	100	100	100	100	100
Estimated cash value	18,850	21,700	20,825	25,775	8,900	9,500	10,900	10,000	10,500	11,800

* Unregistered sire.

II. No animals individually fed.

III. No additions to physical facilities.

IV. Funds expended during fiscal year 1953-54 (make estimates for remainder of year).

Source	Amount Personal Services	Amount Operating Expense and Supplies
9 b3	$ 2,251.14	$ 515.08
9 b1-2	$ 940.77	$ 99.35
Cooperator contribution		$ 1,730.00

Idaho

I. Station: Idaho Agricultural Experiment Station, Moscow and Caldwell, Idaho.

II. Title of Project: The Improvement of Beef Cattle Through the Application of Breeding Methods: (1) Linebreeding within the Hereford and Shorthorn breeds. (2) By testing linebred sires within the various lines which will be developed.

(a) Sub-project: Performance testing of bull calves of purebred beef herds of the State.

III. Personnel: C. F. Sierk, T. B. Keith, R. F. Johnson, C. W. Hickman, W. P. Lehrer, Jr., C. W. Hodgson.

IV. Progress Since Last Annual Report:

(a) Completed alterations and additions to facilities which will materially increase the efficiency of management and collection of data.

(b) A research laboratory has been equipped which will make possible supporting studies in physiology and nutrition.

(c) Continued gathering performance data on cows and calves.

(d) Performance data obtained on two cooperating breeders' herds. These herds are using bulls from the station that had been on feed test. Steer calves will be available in the fall of 1954 for feeding and carcass studies.

(e) Hereford and Shorthorn cow herds divided for 1954 breeding season to start sub-lines in each breed.

(f) Cooperated with one breeder in a rather detailed study of dwarfism in his herd including profiling of young bulls. Numerous discussions of this problem with other breeders and a limited number of profiles taken.

(g) Cooperative bull feeding at Caldwell continued.

V. Future Work:

(a) Continue performance studies including progeny tests on bulls and initiate additional supporting studies in physiology and nutrition as facilities and personnel will permit.

(b) Bull feeding at Caldwell Branch Station terminates this year. Facilities will be used for supporting nutrition studies.

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

I. Cattle Inventory — State: Idaho
A. Purebreds — Date: July 1, 1954

Breed	Hereford	Shorthorn	Angus
Station	Moscow	Moscow	Moscow
Bulls (12 mo. or over)	14	7	2
Cows (2 yrs. or over)	53	31	21
Heifers, yearlings	6	6	4
Male calves	30	7	4
Heifer calves	16	11	4
Percentage use for breeding project	90	90	90
Estimated cash value	32,000	20,000	9,500

II. Young animals which were on feed during 1953-54.

A. Purebred	Hereford Number Individually Fed	Angus Number Individually Fed	Shorthorn Number Individually Fed
Bulls	12 at Moscow 20 at Caldwell	1	5

III. Additions of land, physical facilities and equipment during fiscal year 1953-54.

Item	Actual cash value	Percentage use for beef breeding project
Equipment research laboratory	$2,715	50

IV. Funds expended during fiscal year 1953-54

Source	Amount Non-recurring items	Amount Operating expense
9 b3	300	4,700
State-controlled funds	2,715	16,000

Montana

I. Station: Montana Agricultural Experiment Station and the North Montana Branch Station at Havre, Montana.

II. Title of Project: W-1, M.S. 873, A.I. 104, North Montana Branch Station 71. The Improvement of Beef Cattle Through the Application of Breeding Methods.

A. 1. The establishment of inbred lines of registered Hereford cattle, both horned and polled, that will result in improvement in such characters as rate and economy of gain, fertility, nursing ability, longevity, and carcass quality.

2. Maintain an outbred herd of Herefords with bulls selected and furnished by the purebred breeders. The bulls are to be primarily good, high-scoring individuals according to breed association standards.

B. Establishment of an improved herd of registered Angus cattle in which the males are selected on a high level of performance as indicated by standard record of performance procedures.

C. Investigate feasibility of breeding for specific combining ability through recurrent selection.

III. Personnel:

Leaders:

F. S. Willson, Bozeman
Alva E. Flower, Bozeman
Joseph J. Urick, Havre

Consultants:

C. B. Roubicek, USDA, Denver
J. R. Quesenberry, USDA, Miles City
E. P. Orcutt, Ext. Livestock Spec., Bozeman
John J. Sturm, N. Mont. Br. Sta., Havre

IV. Progress Since Last Annual Report:

Table 1. Summary of Data on Havre Hereford Herds in Recurrent Selection Trials.

Sire	Mean of Test Steers							Mean of Heifers: X-Line Replacement	
	Live Grade*	Carcass Grade**	Area of Loin Eye in Sq. In.	Price Per Cwt.	Dressing %	Slaughter Wt. in Lb.	Daily Gain on Feed Test	Daily Gain 1st Winter	Daily Gain 1st Winter
Sire of Test Steers (HL 3 - No. 615	12.0	9.3	10.30	37.25	61.4	885	2.17	0.84	
(HL 2 - No. 605	13.4	11.4	10.52	37.00	60.8	853	2.24	1.06	
(HL 1 - No. 603	13.1	10.3	9.91	37.00	61.6	850	2.16	0.90	
(Miles City 1 No. 215	14.0	11.8	10.28	36.50	60.7	867	2.11		0.80
Sire of Replacement Heifers (HL 3 F1. Mixer 19									0.72
(HL 2 No. 576									0.92
(HL 1 No. 545									0.86

* B.A.I. Form 101
** B.A.I. Form 102

Referring to 1953-54 the performance of the steers of Havre lines in crosses with Miles City line 1 females as compared to straight Miles City line 1 steers, they tended to make better feedlot cattle this year, in that they gained somewhat faster, had higher slaughter and carcass grades, and sold for more per cwt. on a rail-grade basis. Carcass quality of the crossline steers has excelled the straight-line steers both years of the test. (See Table 1 for heifer and steer comparison. See Table 2 for more detailed carcass comparison).

This station is using carcass data in bull selection. It is possible we may be making progress in our lines in carcass characteristics and natural fleshing beyond and above that which would be attained through ordinary visual selection for acceptable conformation. Relatively high estimates at U. S. Range Livestock Experiment Station and elsewhere of heritability of area of lean in the loin eye muscle would lend support to this contention. Bulls need not be beyond three years of age when confidently selected as sire replacements in their lines.

A check on progress at Bozeman of first-calf 3 year old heifer production has yielded the following information:

Mean daily gains of calves of first-calf heifers themselves calved from 1943 through 1946 was 1.34 lb. Calf production of heifers calved from 1947 through 1950, yielded mean calf daily gains of 1.54 lb. Unless environment influenced gains differentially more than we judge, the above should largely represent genetic gain since data was taken on all Hereford heifers calving, before any were culled from the breeding herd because of calf production. The greatest daily gairs were recorded for calves from the 1950 crop of heifers. These 1953 calves averaged 1.76 lbs. daily gain.

In addition to the 30 head of steers that were group fed this past winter there were 46 head of grade heifers group fed at the Havre Station. There were also 16 purebred heifers group fed. At the Bozeman Station there were 8 purebred heifers and 8 purebred Angus heifers that were group fed.

There were 23 bull calves indexed at the North Montana Branch Station. At the Bozeman Station 8 Hereford bulls and 5 Angus bulls were indexed. After the two top calves in each line at the Havre Station were selected for test breeding, the excess bulls were sold at public auction. The bulls at the Bozeman Station will be sold at private treaty this summer and fall. The usual variation of close to a pound a day in average daily gain was noted. In feed efficiency, however, there was considerably more variation than the average of previous years, i.e., 258 lbs.

The Montana Hereford Association at their annual meeting last March appointed a committee to work with the college in selecting the show type bull that we are to use in our outbred B herd at Bozeman. Heretofore, it has been only a loose arrangement between individual private breeders. It is encouraging to have the Montana Hereford Association back up the program.

Extension livestock specialist and the county agents are continuing to assist breeders with indexing bulls on the ranchers' place. Several breeders have adopted extensive improvement program based primarily on record of performance procedures with the assistance of the extension men.

Table 2.

Second Year Crossline R.O.P. Steers
Summary Winter Feeding and Marketing
North Montana Branch Station - Havre, Montana

Date: October 28, 1953 to May 12, 1954 (196 days).

	Crossline HL_2 605	Sire HL_1 603	Groups HL_3 615	Line Bred Sire Group MC 215
No. of head	7	7	8	8
No. of days fed	196	196	196	196
Wean score	80	79	80	80
Initial wt.	442	455	487	475
Final wt.	881	878	911	889
Total gain	440	423	425	414
Avg. dly. gain	2.24	2.16	2.17	2.11
Total grain fed	2166	2182	2135	2132
Total hay fed	958	972	1132	990
Avg. dly. grain fed	11.1	11.1	10.9	10.9
Avg. dly. hay fed	4.9	5.0	5.8	5.1
Total T.D.N.	2111	2131	2177	2103
Gain/100 lb. T.D.N.	20.8	19.8	19.5	19.7
Marketing Data:				
Shipping wt.	853	850	885	867
Sales wt.	814	817	847	832
Shipping shrink	4.6	3.9	4.3	4.1
Hot carcass wt.	508	515	533	517
Cold carcass wt.	495	502	520	505
Dressing percent 1/	60.8	61.6	61.4	60.7
Slaughter grade 2/	13.4	13.1	12.0	14.0
Carcass grade 3/	11.4	10.3	9.3	11.8
Avg. price/cwt. on rail	$ 37.00	$ 37.00	$ 37.25	$ 36.50
Length of body mm.	1127	1131	1138	1160
Length of hind leg	719	709	723	715
Circumference of round	855	849	868	844
Depth of body	380	381	369	376
Length of loin	589	594	602	589
Width of shoulder	422	427	433	417
Width of round	471	465	475	473
Area of rib-eye sq. in.	10.52	9.91	10.30	10.28
Rib-eye index	239	237	217	219
Fat thickness	13	15	13	15

1/ Using cold carcass wt. and sales wt.
2/ Using B.A.I. Form 101 Slaughter cattle grading chart.
3/ Using B.A.I. Form 102 Beef carcass grading chart.

V. Summary of Progress and Conclusion to Date: I believe most of this heading is covered in item No. 4 above. However, I will say that I believe there is considerably more interest being manifest each year by purebred and commercial men regarding the purchase of stock that have been tested for rapid and efficient gaining ability. Many feeders are coming back to the same people and paying $2.00 to $2.50 per cwt. premium for steers because they are sired by bulls that have been selected for rapid and efficient gaining ability for some time. I think more progress could be made in this direction if we would put a concerted effort on educating the feeders in the corn belt and other areas to the value of feeding steers from high production tested bulls. At our station there has been a difference of $25.00 to $45.00 per steer in net returns above feed cost between the top sire groups as compared with the lowest sire group.

VI. Work Planned for the Future: Plans for the future will be about the same as they were this past year.

VII. Publications and Manuscripts: The last time that publications were listed was in the 1952 report. This list continues on where we left off in 1952.

Publications

Flower, A. E. 1951. Indexing of prospective beef sires. The Montana Galloway, Vol. 1.

Flower, A. E. 1952-53. Series of articles on explanation of inheritance of dwarfism and its control. Stockhand (Extension Specialist Publication, Montana, for County Agent use).

Flower, A. E. 1953. Dwarfism in cattle. Southwestern Veterinarian. Vol. VII, p. 68-69.

Flower, A. E., Fred S. Willson, and Joe Urick. July 1953. Studies on gains of limited-fed steer calves and their subsequent range and full-fed gains. Proc. West. Sec. ASAP, Vol. 4.

Flower, A. E. May 1953. Production with quality is the aim of commercial cattlemen. Montana Stockgrower.

Flower, A. E. March 1954. Indexed beef bulls are worth more. Great Falls Tribune, Special Farm Issue.

Willson, F. S., A. E. Flower, and E. P. Orcutt. 1953. Bull indexing as a selection procedure in the improvement of beef cattle. Mont. Agr. Exp. Sta. Bull. 487.

BEEF BREEDING PROJECT SUMMARY

Fiscal Year 1953-54 Bozeman

State Montana

Date 6-1-54

I. Cattle Inventory

A. Purebreds

Havre

Line designation	H.L. 1	H.L. 2	H.L. 3	MC Tester	L. A	L. B	L. C
Breed	Polled Hereford	Horned Hereford	Horned Hereford	Grade Hereford	Inbred Hereford	Outbred Hereford	Angus
Station	N.M.B.S.	N.M.B.S.	N.M.B.S.	N.M.B.S.	Bozeman	Bozeman	Bozeman
Bulls (12 mo. or over) @$500	5	7	6	1	7	2	6
Cows (2 yrs. or over) @$250	24	34	31	107	26	11	20
Heifers, yearlings @$150	3	8	6	65	7	1	8
Male calves @$100	5	17	13	42	8	3	10
Heifer calves @$100	10	12	8	53	13	4	8
Percentage use for breeding project	100	100	100	100	60	60	60
Estimated cash value	10,450	16,100	13,750	38,775	13,150	4,600	11,000

A. Purebreds at North Montana Branch Station

Bulls	23	16	None			None	
Heifers							
Steers							

B. Grades

Bulls		46					
Heifers		44					
Steers							

II. Young animals which were on feed during 1953-54.

B. Purebreds at Bozeman Station

	Herefords		Angus		Shorthorns	
	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed
Bulls	8	8	5	8	None	
Heifers						

III. Additions of land, physical facilities and equipment during fiscal year 1953-54.

Item	No.	Actual Cash Value	Percentage use for beef breeding project	Remarks
NONE.				

IV. Funds expended during fiscal year 1953-54 (make estimates for remainder of year).

Source	Amount Non-recurring Items	Amount Operating Expense
9 b3	None	5,800
BAI Funds	None	2,400
State-controlled Funds	None	36,300
	Total	44,500

Nevada

I. Station: Nevada Agricultural Experiment Station, Reno, Nevada.

II. Title of Project: The effect of environment on selection for traits of economic importance; the relative value of several selection criteria; and reproductive studies in range beef cattle.

III. Personnel: James F. Kidwell, leader; W. G. Black, V. R. Bohman, J. E. Hunter, C. R. Torell, assistants; J. H. Robertson, F. N. Neville, L. O. McCartney, W. B. Dye, J. A. McCormick, cooperators - Permanent and temporary farm labor, student assistants. R. T. Clark, C. B. Roubicek, coordination.

IV. Progress Since Last Report: The Nevada project was completely revised during the past year. The revision was based on an analysis of previous work, the requirements of the industry, and Nevada's potential contribution to the W-1 project. Since copies of the project have been circulated, details need not be repeated.

A breeding herd has been established at the Knoll Creek Range Station. This herd consists of two one-sire lines. One line is being selected on the basis of rate of gain and the other on the basis of economy of gain.

Three lines have been established at Reno. One line is being selected for rate of gain, one for economy of gain and one on the basis of a conformation score.

Every animal in all lines is individually fed for 140 days post-weaning. All calves were individually fed at Reno and Knoll Creek last year.

A pelleted ration consisting of 2 parts grass and clover hay to 1 part grain concentrate was developed for the Reno herd. Calves at Knoll Creek are tested on native hay.

In cooperation with the Department of Farm Development and Extension Service, 12 bulls from 6 Nevada breeders were indexed at the Fallon Station this year. This introduced the technique as an aid to selection to Nevada beef producers. A circular describing the technique and this trial has been prepared.

During the past year the antipyrene technique has been further perfected. It now seems clear that this method can be of practical use in a wide variety of research problems.

Analyses of accumulated data have been completed during the past year. A study of growth relations in range cattle was completed. A paper describing the study appeared in the Journal of Animal Science, 13:1, pp 54-60.

An analysis of data comparing rate of gain of individually and group fed calves was completed. This analysis indicated that, under the conditions of these trials, calves fed on a higher plane of nutrition will gain at a higher rate when fed in groups or pairs than when fed in individual pens. On a lower plane of nutrition method of feeding makes little difference in rate of gain. A paper describing the study will appear in the August issue of the Journal of Animal Science.

A study of growth, carcass quality and composition, and cut out values of Holstein steers was made. A comparison with Hereford steers was available. The results of this study have implications for beef cattle breeding and improvement. A circular describing the Holstein growth phase has been published, and a more comprehensive station bulletin is in press.

Analysis of data from the mildly inbred Holstein herd at Fallon presented further evidence of genes conditioning female sterility. This study serves to further stress the need for caution against deleterious recessive genes in establishing inbred lines.

Detailed measurement data, live slaughter grade, carcass grade and dressing percent was collected on a group of 87 fat steers. This data will be analyzed to study further possible relations between body form or conformation as expressed in terms of ratios of body parts and slaughter grade, carcass grade and dressing percent.

Detailed body measurements are being taken on calves at the Reno station. These measurements will be analyzed to study the early post-partum allometric growth of Hereford cattle. Previous work has indicated the feasibility of the allometric technique in studies of conformation.

Five generation pedigrees have been completed and checked for accuracy on all purebred animals in the project. A covariance chart is being constructed.

A barn, corrals, and field laboratory have been constructed for use in the studies of reproductive physiology associated with the project. Six heifers are being used in the studies dealing with synchronizing the estrus cycle. A spayed heifer is being used as a "teaser".

A study of the effect of winter mineral supplement on reproductive rate, calf weights, etc., was initiated at the Knoll Creek Station.

The Department of Agricultural Chemistry has made studies of an electrophoresis process to separate various globulins in pathological blood serum of sheep. Blood samples were obtained from Dr. Gregory at the California Station. Presumably these samples were from dwarf, heterozygous and proven normal animals. It was thought possible that these groups might be separated on the basis of the globulin patterns.

The technique will require some modification for bovine serum. Limited staff has retarded this study; however, it appears reasonable to conclude

at this time that the technique has definite possibilities as an aid in identifying individuals heterozygous for the dwarf conditioning gene. The technique appears worthy of further investigation.

Although not requiring as large a proportion of total time, effort and funds as previously, physical facilities continue to present a problem. Great improvements of the farms and laboratories have been initiated during the past year.

V. Summary of Progress and Conclusion to Date:

A summary of the progress of the project since its inception can be presented only in broad terms. Detailed accomplishments are available in other publications. Perhaps of greatest significance is the fact that this project has provided the establishment of a herd of nearly 100 breeding females devoted primarily to breeding research. This is a major accomplishment in view of the fact that only five years ago this institution owned not a single breeding cow. Closely associated with the establishment of a herd of cattle devoted to breeding research, has been the establishment of a closely knit, young, vigorous, and for the most part well trained competent research staff. The staff is well balanced, in that all of the biological disciplines fundamental to beef cattle improvement are brought to bear on problems of animal breeding. The project has resulted in the accumulation of facilities for beef cattle breeding research. While it is well known that elaborate facilities alone do not assure sound research, certain basic items are essential. This project is providing the essentials. Perhaps the greatest contribution the project has made is to arouse an awareness of and interest in the potentialities of animal breeding research in the improvement of range cattle among Nevada's range operators. Already this is being reflected in improved practices among many range operators in Nevada.

A discussion of the advancement in technical knowledge arising from this project is available in the references cited at the end of this and previous annual reports. The details need not be repeated. It should be pointed out that five years represents only about one generation of beef cattle. A wealth of analysis and publications could hardly be expected, indeed would not be in order, in such a short time. As one might expect, the majority of the effort of the project since its inception has been to lay a firm foundation for future work.

VI. Work Plan for the Future:

Details of the work plan for the future are provided in the revised project. Items that will receive particular attention during the coming year include:

1. Individual feeding of all calves born in 1954.
2. Further development and refinement of the antipyrene technique.
3. Further studies on synchronizing the estrus cycle of range cattle.
4. A survey of causes of reproductive failure in range cows.
5. Analysis of existing data.
   a. Early allometric growth.
   b. The relationship between conformation and certain productive traits.
6. Continue bull indexing in cooperation with ranchers.

VII. Publications and Manuscripts Prepared Since Last Annual Report:

Kidwell, J. F. 1953. Some growth relations in range Hereford cattle. (Abstract). Proceedings Annual Meeting Western Section American Society of Animal Production. 1953. I-1.

Kidwell, J. F. 1953. Growth relations in range cattle. (Abstract) Journal of Animal Science, 12:895.

Kidwell, J. F. 1954. Some growth relations in range cattle. Journal of Animal Science, 13:54.

Kidwell, J. F., V. R. Bohman, and J.E.Hunter. 1954. A comparison of individual and group feeding of experimental beef cattle as influenced by maturity of hay. Journal of Animal Science, 13:__.

Kidwell, J. F., L. Walker, and J.A. McCormick. 1954. Hereditary female sterility in Holstein-Friesian cattle. Journal of Heredity (in press).

Kidwell, J. F., and J. A. McCormick. 1954. Growth of Holstein steers on an all-roughage ration. Nevada Agricultural Experiment Station Bulletin. (In press).

Kidwell, J. F., J. A.McCormick, L. O. McCartney and J. E.Hunter. 1954. Bull indexing as an aid to selection in the improvement of range beef cattle. University of Nevada publication. (In press).

McCormick, J. A., and J. F. Kidwell. 1953. Producing beef from Holstein steers. Nevada Agricultural Experiment Station Circular No. 3.

I. Cattle Inventory
A. Purebred

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

State Nevada
Date June 1954

Line designation	I	II	III	
Breed	Hereford	Hereford	Hereford	
Station	Reno	Reno	Reno	
Bulls (12 mo. or over)	1	1	2	
Cows (2 yrs. or over)	22	23	22	
Heifers, yearlings	4	4	4	
Male calves	10	11	8	
Heifer calves	9	9	10	
Percentage use for Breeding project	95	95	95	
Estimated cash value	$6,400.00	$6,650.00	$6,700.00	

B. Grades

Line designation	I K	II K	
Breed	Hereford	Hereford	
Station	Knoll Creek	Knoll Creek	
Bulls (12 mo. or over)	1	1	
Cows (2 yrs. or over)	15	16	
Heifers, yearlings	3	5	
Male calves	6	7	
Heifer calves	8	7	
Percentage use for Breeding project	100	100	
Estimated cash value	$2,775.00	$3,075.00	

II. Young animals which were on feed during 1953-54.

A. Purebreds

	Herefords		Angus		Shorthorns	
	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed
Bulls	7	0	0	0	0	0
Heifers	19	0	0	0	0	0
Steers						

B. Grades

Bulls	0	0	0	0	0	0
Heifers	8	10	0	0	0	0
Steers	0	20	0	0	0	0

III. Funds expended during fiscal year 1953-54 (make estimates for remainder of year).

Source	Amount Non-recurring items	Amount Operating expenses
9b3	None	$ 3,900.00
BAI funds	$ 175.00	None
State-controlled funds	-	-
BHJ 9b1&2	$ 1,200.00	$ 6,900.00
Experiment Station Offset	$13,000.00	$12,310.00
Station Sales	$ 800.00	$ 490.56
Sears-Roebuck	$ 1,500.00	None

New Mexico

I. Station: New Mexico Agricultural Experiment Station, State College, New Mex

II. Title of Project: Breeding Beef Cattle for Southwestern Ranges.

III. Personnel: Robert L. Blackwell, J.H. Knox, and W. E. Watkins.

IV. Progress Since Last Report:

The feeding of the first group of type calves selected on their own phenotype has just been completed. Carcass data and feedlot data have been collected from these cattle as well as on a group of older steers produced on the college ranch. Thyroid glands were obtained from the type calves for study of the relationship of thyroid activity to feedlot performance.

The lignin determinations on the feces of range cattle are being continued to obtain estimates of the relative consumption of range forage by the two types. Feed consumption appears to be proportional to size both in the feedlot (steer calves) and on the range (cows and heifers).

A preliminary study was made of the relationship of beef type to yield, percentage of wholesale cuts and hide areas. A linear relationship between surface area and body weight was found within the range of 500 to 1,250 pounds. Surface area increased 2.1 square feet for each 100-pound increase in size. Differences between large and compact cattle in surface area were essentially removed when weight was controlled statistically. Estimations of body length, body depth, and length of leg by visual appraisal were positively correlated with their respective carcass measurements, the values of the correlations being of the order 0.22 to 0.38.

The correlations between weight and the percent carcass yield of round, chuck, loin, and rib were negative within types and years, while the correlations between weight and percent of yield of plate, flank, and kidney and fat were positive.

An analysis of the effect of mild inbreeding on weaning weights and grade was made with the following major findings: when age of calf, sex of calf, and weight of dam at 18 months were controlled statistically, the partial regression of weaning weight on percent inbreeding of the calf within years was -0.74 pounds with a standard error of 0.266. Within sires and years, the partial regression was -0.63 ± 0.307. The partial regression of weaning weight of the calf on the inbreeding of the dam was 0.95 ± 0.433. The effect of inbreeding on grade although negative was of little practical significance. The inbreeding study involved 1,455 calves sired by 34 bulls over a 14-year period. The inbreeding coefficients which were computed for this study will be used to study the effect of inbreeding on other measurements of performance. The range in inbreeding coefficients was 0 to 25 for calves and 0 to 16 for dams.

With regard to inbreeding of calf on weaning weight, considerable yearly variation in the estimates were observed when each year's data were

analyzed separately. The range in the partial regression coefficients was -3.50 to 0.20 pounds for each percent inbreeding of the calf.

A study was made of the phenotypic and genetic relationships between type and weight of range cattle at different periods. It involved the following observations: weaning weight and grade, long yearling (18 mo.) weight and grade, and gain on the range from weaning to long yearling. The data were from cows which calved as three-year-olds and their first calf.

Heritability estimates based on intra-sire and year dam-offspring regressions were:

Weaning weight	-0.06 ± 0.114
Yearling weight	0.37 ± 0.230
Weaning grade	0.26 ± 0.112
Yearling grade	0.63 ± 0.132
Yearling gain	0.24 ± 0.256

The phenotypic and genetic relationships are shown in the following table:

	Weaning Grade	Yearling Weight	Yearling Grade	Yearling Gain
Weaning Weight	0.16**	0.59**	-0.05	0.21*
	---	---	---	---
Weaning Grade		-0.07	0.61**	-0.12
		-0.93	0.83	-0.31
Yearling Weight			0	0.77**
			-1.12	1.69
Yearling Grade				0.04
				-0.74

The top figures of each pair are the phenotype correlation and the lower figure is the genetic correlation.

No estimates of genetic correlations between weaning weight and other traits were forthcoming from this analysis due to the negative estimates of heritability for weaning weight.

The simple correlations between weaning weight of the dam and the other traits on the calf and between weaning weight of the calf and the other traits on the dam indicate that negative genetic correlations exist between weight and grade at weaning and at yearling, while a positive genetic correlation exists between weaning weight and gain.

The regression of 18 months weight of the dam on weaning weight of her calf has been estimated to be between 0.10 and 0.24 pounds.

The presence of a lethal condition at birth which appears to be a simple autosomal recessive has led to a study of all calves at birth in the purebred herd and of all calves on the range that die for any cause. Body measurements are recorded and dead calves are posted with special attention being given to head, vertebrae, and long bones. Internal hydrocephalus has been found in the abnormal calves and closure of the supra-orbital foramen appears to be associated with the lethal condition. Progeny testing of bulls in the experimental herd for this condition continues. No new carrier bulls have been found within the year.

More data on individual bull feeding is being collected.

V. Summary of Progress and Conclusion to Date:

The studies of the factors which are involved in breeding beef cattle for southwestern ranges have been directed primarily toward obtaining estimates of heritability of traits of economic importance, the relationships which exists between these traits, and important sources of non-heritable variation. Data on cow productivity as measured by the weaning weight and grade of calves, the regularity of production, the length of productive life, and freedom from unsoundness have been collected in the experimental herd for a number of years. These data and breeding records are the basis for the major studies. The extension program now in progress for beef cattle improvement in New Mexico has evolved primarily from this work, and is receiving favorable reception by the cattlemen of the State.

The heritability of type in beef cattle as measured by a visual grade at weaning has been estimated to be approximately 25 percent. The phenotypic correlations between weaning grade and subsequent performance of steers in the feedlot have been found to be essentially zero. A preliminary study of genetic correlations between grades and weight or gains on the range at different periods indicate a rather marked negative relationship. It would appear, therefore, that selection for type or grade in beef cattle will yield no other benefit than to improve grade. A decline in size can be expected to accompany intensive selection for high grade when compactness is a component of grade and is considered desirable.

A study of apparent efficiency in the feedlot of compact calves compared to large type calves indicates a similar ability to convert feed into beef. Feed consumption in the feedlot is essentially the same per unit weight for the two types and estimates of feed consumption on the range obtained by lignin determination of the feces strongly indicate that the same is true there.

Weights and gains of steers on the range at different periods were found to be positively correlated with feedlot gain and with each other. Weights and gains of heifers on the range at different periods also are positively correlated.

The heritability of size at 18 months of age and of yearling gain on the range indicates that selection at this age for size or gain will be effective. The effectiveness of selection for weaning weight leads to the conclusion that the zero estimate of heritability of weaning weight reported in this communication is an underestimate.

Preliminary summaries of incidence of cancer eye in Hereford cattle indicate an hereditary involvement since sire groups differ greatly.

A study of calving interval in Angus cows resulted in a heritability estimate which was essentially zero with years, seasons, and calving sequence being the most important of variation. Heritability of gestation length was estimated to be of the order of zero to 16 percent. From this it is tentatively concluded that any selection for these two measures of reproductive fitness will be of little benefit in bringing about genetic improvement, although the economics of beef production necessitates the culling of cows which do not calve regularly.

VI. Work Plan for the Future: Continue to collect the pertinent data on the experimental cattle.

Make a preliminary study of the relative thyroid activity of the type steers fed out in 1953-54.

Enlarge the study of genetic relationships among traits measured on the range and in the feedlot, and study further the effects of mild inbreeding on these traits.

Study further the components of cow productivity on the range.

Continue to study the carcass and feedlot differences on the type steers.

VII. Publications and Manuscripts During the Year:

Brown, Lans O. 1953. An analysis of the sources of variation in the length of the calving intervals of beef cattle. M.S. Thesis.

Brown, Lans O., Ralph M. Durham, Estel Cobb, and J. H. Knox. 1954. An analysis of the components of variance in calving intervals in a range herd of beef cattle. Journal of Animal Science, 13: 511.

Durham, Ralph M., and J. H. Knox. 1953. Correlations between grades and gains of Hereford cattle at different stages of growth and between grades at different times. Journal of Animal Science, 12: 771.

Hudson, Frank A. 1953. Relationship of beef type to yield percentage of wholesale cuts and hide area. M.S. Thesis.

McCleery, Neil B. 1954. The effect of mild inbreeding on weaning weight and grade of Hereford cattle. M.S. Thesis.

Romo, Anthony. 1954. Phenotypic and genetic relationships between type and weight of range cattle at different periods. M.S. Thesis.

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

I. Cattle Inventory

State New Mexico
Date June 18, 1954

A. Purebreds

Line designation	Old Line	Out Cross Line
Breed	Hereford	Hereford
Station	Main	Main
Bulls (12 mo. or over)	9	8
Cows (2 yrs. or over)	13	34
Heifers, Yearlings	4	14
Male calves	1	13
Heifer calves	5	10
Percentage of use for breeding project	65	65
Estimated cash value	10,900	18,450

B. Grades

Line designation	Big	Medium	Compact
Breed	Hereford	Hereford	Hereford
Station	Main	Main	Main
Bulls (12 mo. or over)	0	0	0
Cows (2 yrs. or over)	34	62	31
Heifers, yearlings		14	
Male calves	13	25	10
Heifer calves	13	25	11
Percentage use for breeding project	50	30	50
Estimated cash value	4,300	9,540	4,150

II. Young animals which were on feed during 1953-54.

A. Purebreds

	Herefords	
	Number individually fed	Number group fed
Bulls	24	0
Heifers	0	21
Steers	0	9

B. Grades

Bulls	0	0
Heifers	0	0
Steers	0	47

III. Additions of land, physical facilities and equipment during fiscal year 1953-54.

Item	No.	Actual Cash Value	Percentage use for beef breeding project	Remarks
NONE				

IV. Funds expended during fiscal year 1953-54 (make estimates for remainder year)

Source	Amount Non-recurring items	Amount Operating Expense
9 b3		$ 8,000.00
BAI funds		3,200.00
State-controlled funds		10,923.00

Oregon

I. Station: Oregon Agricultural Experiment Station, Corvallis, Oregon.

II. Title of Project: Improvement of Beef Cattle Through the Application of Breeding Methods.

III. Personnel:

Ralph Bogart, Leader
Hugo Krueger
A. W. Oliver
Andrea Mackey
J. E. Oldfield
A. C. Warnick
M. J. Burris
John Kaufmes
H. Schultz
Phyllis Touchie
C. M. Williams
Lloyd Williams
M. A. MacDonald
R. R. Wheeler
G. E. Nelms
M. M. Oloufa
A. A. Rasheed

Central Station
Corvallis, Oregon

W. A. Sawyer, Farris Hubbert, Jr. - Squaw Butte-Harney Station, Burns, Oregon.
H. G. Avery & Cecil Pierce - Eastern Oregon Branch Livestock Station, Union, Oregon.
E. N. Hoffman - Malheur Experimental Area, Ontario, Oregon

IV. Progress Since Last Annual Report:

1. Bred cows to further the development of the three lines of Herefords and one line of Angus.

2. Scored, measured and photographed, using a 6" grid behind which the animal stands, all animals at 500 pounds when they started on feed test and again at 800 pounds when they completed the feed test.

3. Pelleted feed for test calves in ratio of 2 parts alfalfa hay to one part concentrate with one inch pellets which were very palatable. This made it possible to get good food consumption, keep ratio of hay to grain constant, and to know exactly what each calf ate and refused in quality as well as quantity. Thus, our error was reduced to practically zero in this respect.

4. Feed tested calves (both male and female) in the 3 lines of Herefords and the Angus line.

5. All bulls were offered to an estrogenized heifer bi-weekly. This was to check for puberty. All heifers were checked daily for first heat, as a check for puberty.

6. Cooperated with the extension personnel in profiling bulls to differentiate dwarf carriers from clean ones as a service to breeders. The profiles are taken by the extension men and keyed out in the laboratory.

7. Calculated feed intake above maintenance cost for calves to compare efficiency on this basis with overall efficiency.

8. The following measurements were made on 4 female and 2 male calves of the Lionheart line each week from birth to a weight of 400 pounds and then at weights of 500, 600, 700, and 800 pounds: Head length, head width, height at loin, height at withers, chest depth, length from hocks to pins, length from shoulder point to pins, round measure from patella to patella horizontally, circumference of front cannon, width of chest, and heart girth. The same measurements were taken on all the other calves when they weighed 400, 500, 600, 700, and 800 pounds.

9. The following analyses were run on the blood of 4 female and 2 male calves of the Lionheart line each week from birth to a weight of 400 pounds and then at 500, 600, 700, and 800 pounds: Uric acid, urea, amino acid, haemoglobin, and creatinine. The same analyses were run on the blood of all other calves when they weighed 400, 500, 600, 700, and 800 pounds.

10. Initiated a study using rabbits in which the cytoplasmic material, maternal effects both prior to and following birth, and post weaning environments are held constant with genetics varying. New Zealand does are mated to bucks of Polish (2 to 3 pounds mature weight), New Zealand (9-10 pound mature weight), and Flemish Giant 16-20 pound mature weight). The young are studied for gains, feed efficiency, and body proportions.

11. Prepared manuscripts for several publications. (See list).

12. Analyzed data on factors affecting net efficiency of beef cattle. Maintenance was calculated as a constant function of body weight. This was subtracted from the TDN consumed to give net efficiency. Net efficiencies were correlated with birth weight, age and rate of gain within lines and sexes. Also, the regression of net efficiency on body weight and feed intake were calculated.

13. Initiated a study on digestibility by the ratio technique using chromogens and chromic oxide as the inert substances.

14. Initiated a study on blindness in the Angus cattle to see if the eye trouble is due to an inability of the animals to convert carotene into Vitamin A. Eyes of cattle are being studied and carotene and Vitamin A of the blood are being determined.

15. All calves that die or are born dead are examined very carefully for dwarfism, particularly the head is opened for hydrocephalic examination.

16. Revised the beef cattle breeding project plans.

17. Studied the response of calves to weaning. How the calf adjusts itself to the weaning regime is being related to its previous performance such as birth weight, rate of gain, age, etc. Also, its response to weaning is related to subsequent performance with such traits as rate of gain, feed efficiency, etc., being considered.

18. Used 64 rabbits on a study of the effects of sex hormones on rate and efficiency of gains and kind of body stores using the following experimental design:

Hormone Treatment	Kind of Rabbits: Males		Females	
	Intact	Castrate	Intact	Castrate
Control	4	4	4	4
Testosterone	4	4	4	4
Estradiol	4	4	4	4
Stilbestrol	4	4	4	4

The hormones were injected for six weeks twice weekly at the following rates: testosterone, 1 mg/rabbit; stilbestrol, .04 mg/rabbit; and estradiol, .017 mg/rabbit.

19. Obtained gain per day, feed consumption per day and feed per unit of gain for each rabbit.

20. Slaughtered each rabbit and obtained dressing percent, colored photograph of each carcass, and chemical analyses on the fat and protein of the fat and lean portions of the carcasses.

21. Obtained weights on the liver, adrenals, thyroid, pituitary, and gonads. Fixed for histological studies tissue from the thyroid, adrenals, pituitary, and reproductive tract.

22. Determined iodine numbers of fat in all rabbit carcasses.

23. Determined cooking losses for each rabbit during the cooking process.

24. By use of a panel of judges, a cooked sample of meat from each rabbit was appraised for flavor, odor, tenderness, and juiciness.

25. Froze a sample of meat from each rabbit to determine keeping qualities of the carcasses.

26. Injected one heifer and one steer with testosterone at the rate of 1 mg. per kg. per week and left one of each with no treatment so that negative and positive controls were provided. Compared animals with the above when a single dose of high potency aqueous solution or a single dose of high potency oil solution of testosterone was injected. Used stilbestrol and estradiol on steers.

27. At the Eastern Oregon Station steers receiving a single dose of stilbestrol were compared with control steers. Also, heifers receiving high potency testosterone were compared with control heifers.

28. Carcass studies on hormone-treated cattle at the Central Station will include:

a. Dressing percent.
b. Wholesale cut outs.
c. Protein, moisture and fat analyses on the carcasses.
d. Cooking losses of rib roast.
e. Meat palatability and tenderness appraisals.

29. Analyzed the blood at 400, 500, 600, 700 and 800 pound weights for the following: uric acid, urea, amino acids, haemaglobin and creatinine.

30. A biological test for the sex hormone remaining in the carcasses of rabbits and cattle that had been treated was made.

The Improvement of a Commercial Beef Cattle Herd Through the Use of a One-Sire Breeding Herd

A. Breeding Herd

Twenty-eight cows and 4 replacement heifers grazed on meadow pasture at the Section Five Unit of the station from April 28 until hay feeding was initiated in December.

The sire used in the breeding herd was WC Domino Prince 59 (tatoo 59). The breeding season extended from May 29 through October 1.

Twenty-six calves were born to the 28 cows in the herd. One calf died at birth and 1 calf died at approximately one month of age (cause unknown). Twenty-four calves were weaned on November 11, 1953, at an average weight of 444 pounds.

B. Commercial Herd

A total of 100 cows were carried in the commercial herd. Ninety-one calves were born, including 2 sets of twins. Eighty-eight calves were weaned on November 11, 1953, at an average weight of 420 pounds.

Seven bulls (tatoo numbers, 89, 69, A9, 88, 130, 99, and 82) were with the cows during the breeding season which extended from May 29 through September 29, 1953.

A Comparison of Rations for Testing the Ability of Beef Cattle to Gain in the Dry Lot and on the Range

Twenty-two weaner heifers from the commercial herd and 6 weaner heifers from the breeding herd were randomly assigned to rations 1 and 2. An equal number of heifers from each source was assigned to each ration.

Ration 1 consisted of: 2 pounds of barley, 1 pound of cottonseed meal, and a full-feed of mixed hay (25% alfalfa-75% meadow hay). Ration 2 consisted of: 1/2 pound cottonseed meal, full-feed of ground barley, and a full-feed of mixed hay (50% alfalfa-50% meadow hay).

The winter test period was initiated on December 23, 1952, and was terminated on April 20, 1953. The grazing phase of the study then extended from May 8, 1953, through September 24, 1953.

1. Bred registered cows to feed tested bulls to further improve the registered line of Herefords.

2. Bred grade cows in one-sire blocks to registered (feed tested) bulls.

3. Completed stall feeding of 15 registered Hereford calves, 9 heifers and 6 bulls.

4. Tests now in progress include:

   a. Individual stall feeding of 12 registered bulls and 5 registered heifers. All registered calves this year were weaned at a constant age of 210 days, and are being fed on test 120 days each.

      Stall calves this year are being fed an all pelleted ration containing alfalfa-grass hay 1/3 and concentrate 2/3.

   b. The first phase of the weaner calf wintering research program began last fall. The test includes eight lots of six calves each. These were produced by the station grade herd. Four lots of steers and four lots of heifers are being wintered on four different levels of gain, with one lot of steers and one lot of heifers on each level. The gain is being held to a minimum, a maximum, and two intermediate levels. All are being fed the same ration, alfalfa-grass hay 2/3 and barley 1/3, with amounts varied to produce different levels of gain. Those on maximum feed intake will be marketed this spring. All others will be pastured through the summer and marketed this fall. Costs of beef produced will be computed to determine most efficient level of winter feeding.

   c. Six heifers are now being fed on a hormone trial to measure the value of one injection of slowly absorbable testosterone on rate and efficiency of gain.

   d. Ten steers are being fed on a second hormone trial designed to measure the effect of one implantation of diethylstilbestrol pellets and rate and efficiency of gain.

V. Summary of Progress and Conclusion to Date:

Major Accomplishments or Progress of Project Since Its Inception

1. Bulls gain faster and require less feed than steers; and steers in turn are superior in this respect to heifers. It appears that a portion of this difference between the heifers and bulls is attributable to the male sex hormone. Testosterone at a dosage level of 1 mg/kg of body weight per week injected intramuscularly during the test period from a weight of 500 pounds to weight of 800 pounds increased the rate of gain and reduced the feed necessary for making each unit of gain in both heifers and steers. Heifers treated with testosterone responded with a greater increase in rate and economy of gain over the control heifers than the testosterone treated steers over the control steers. The heifers were not brought up to the level of normal bulls, whereas the steers were. The non-masculinizing

male hormone, Methyl androstenediol, had no significant effect on rate and economy of gain; therefore, it appears that rate and efficiency of gain may be associated with the masculinizing principle of the male hormone. Methyl testosterone fed to steers at the rate of 1.5, 3.0 and 6.0 grams per 100 pounds concentrate with the allowance of concentrate at 0.8 pounds per 100 pounds live animal weight did not statistically increase rate of gain and feed efficiency but it did cause some masculinizing and did affect the carcass by increasing nitrogen and reducing fat storage. The variation in this group of steers was great which may account for gain and efficiency figures showing non-significance.

2. There seems to be little relation between rate or economy of gain and scores for conformation. This is encouraging in that it appears possible to secure good appearing cattle that are rapid and efficient in their production. The relation of rate of gain to feed efficiency is very close; therefore, the ranchers who select only for rate of gain will get a good bit of improvement in economy of gains also.

3. Larger cows wean heavier calves than smaller ones.

4. Correction factor of 1.29 pounds per day for adjusting the weaning weights of range beef calves to a constant age basis has proven accurate.

5. Cancer eye seldom, if ever, occurs in "red-eyed" Herefords.

6. During a three-year period ending in June 1952, bull calves have averaged 0.29 pound per day increase in average gain-on-test, and have increased in efficiency of gain by an average decrease of 60 pounds TDN for each 100 pounds gain in live weight.

7. Statistical analysis of this three-year data shows the following:

With individually fed calves--

(1) Birth weight had a significant effect on gain-on-test, and on gain-from-birth-to-the-end-of-test.

(2) Weight-on-test had a significant effect on total gain from birth-to-the-end-of-test.

(3) Age-on-test had a significant effect on gain-on-test.

(4) Suckling-gain had no effect on gain-on-test, economy-of-gain, or total-gain-from-birth-to-the-end-of-the-test-period.

(5) Neither birth-weight, suckling-gain, nor weight-on-test or age-on-test had any effect on economy of gain during the test period.

(6) There was a significant regression of economy of gain on rate of gain.

With group fed calves--

(1) Birth-weight had a significant effect on gain-on-test and total gain.

(2) Suckling-gain had a significant effect on gain-on-test and total gain.

(3) Weight-on-test had a significant negative effect on gain-on-test and a significant positive effect on total gain.

(4) Age-on-test had a significant effect on gain-on-test.

(5) Neither weight nor age-on-test had any effect on gain-from-birth-to-the-end-of-test.

8. Heart rate seems to be related to rate and efficiency of gains. The better performing groups of cattle have a higher heart rate. Thus, Angus bulls averaged 106.8, Hereford bulls 105.0, Hereford heifers 102.0, and Angus heifers 101.0.

9. Normal values for blood glucose at 500 and at 800 pounds live weight are presented in Table 1.

Table 1. Blood Glucose Concentrations of Experimental Groups at 500 and at 800 Pounds Body Weight.

	Blood Glucose (mg./100 ml.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	45	58	92	41	42	66	92	46
All males	19	58	77	44	18	64	89	46
All females	26	59	92	41	24	67	92	51
All Herefords	28	58	92	41	26	67	92	49
All Angus	17	58	77	46	16	63	92	46

10. Normal values for haemoglobin of beef cattle at 500 and at 800 pounds body weight are presented in Table 2.

Table 2. Blood Haemoglobin Levels of Experimental Groups at 500 and 800 Pounds Body Weight.

	Blood Haemoglobin (gm./100 ml.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	45	12.0	13.5	10.3	42	12.4	16.2	10.5
All males	19	11.8	12.5	10.5	18	12.2	13.4	10.5
All females	26	12.1	13.5	10.3	24	12.7	16.2	10.6
All Herefords	28	11.8	13.2	10.3	26	12.2	13.6	10.5
All Angus	17	12.2	13.5	11.0	16	12.9	16.2	11.3

11. Normal values for blood urea nitrogen for calves at 500 and at 800 pounds live weight are presented in Table 3.

Table 3. Blood Urea Nitrogen Levels of Experimental Groups at 500 and 800 Pounds Body Weight.

	Blood Urea Nitrogen (mg./100 cc.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	45	17.66	29.42	6.67	42	15.38	24.17	8.81
All males	19	15.79	28.04	9.20	18	14.31	19.96	8.81
All females	26	19.03	29.42	6.67	24	16.19	24.17	9.28
All Herefords	28	16.90	29.42	8.84	26	15.17	23.33	10.03
All Angus	17	18.93	29.42	6.67	16	15.72	24.17	8.81

12. Normal values for blood amino acid for calves at 500 and at 800 pounds live weight are presented in Table 4.

Table 4. Blood Amino Acid Nitrogen Levels of Experimental Groups at 500 and 800 Pounds Body Weight.

	Blood Amino Acid Nitrogen (mg./100 cc.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	45	7.10	8.83	4.10	42	7.28	8.66	5.34
All males	19	6.72	8.03	4.10	18	6.80	8.26	5.34
All females	26	7.38	8.83	4.76	24	7.64	8.66	6.16
All Herefords	28	6.94	8.10	4.74	26	7.09	8.52	5.34
All Angus	17	7.36	8.83	4.10	16	7.59	8.66	6.98

13. Normal values for blood creatinine for calves at 500 and 800 pounds live weight are presented in Table 5.

Table 5. Blood Creatinine Levels of Experimental Groups at 500 and 800 Pounds Body Weight.

	Blood Creatinine (mg./100 cc.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	45	1.58	2.70	0.80	42	1.39	2.64	0.60
All males	19	1.59	2.70	0.90	18	1.37	2.64	0.63
All females	26	1.57	2.70	0.80	24	1.41	2.37	0.60
All Herefords	28	1.51	2.70	0.90	26	1.61	2.64	0.63
All Angus	17	1.69	2.70	0.80	16	1.05	1.24	0.60

14. Normal values and ranges for blood uric acid for calves at 500 and at 800 pounds live weight are presented in Table 6.

Table 6. Blood Uric Acid Levels of Experimental Groups at 500 and 800 Pounds Body Weight.

Group	Blood Uric Acid (mg./100 cc.) 500 lbs. Calves	Ave.	High	Low	800 lbs. Calves	Ave.	High	Low
All animals	45	2.02	3.43	1.19	43	2.00	4.11	0.98
All males	19	2.06	2.60	1.31	18	1.92	2.72	0.98
All females	26	1.98	3.43	1.19	24	2.06	4.11	1.05
All Herefords	28	1.84	2.50	1.19	26	1.76	2.35	0.98
All Angus	17	2.31	3.43	1.25	16	2.39	4.11	1.33

15. Blood glucose, haemoglobin, and amino acid nitrogen concentrations all increased with the increase in body weight from 500 to 800 pounds.

16. Blood urea concentrations decreased with the increase in body weight from 500 to 800 pounds.

17. Marked changes in blood constituents occurred within the first 6 weeks of the calf's life. This indicated a shift in metabolism from fetal to post-partum growth.

18. Animals decrease in both overall and in net efficiency with increases in size. Males show a more marked change in efficiency with size increase than do females.

19. Heifers are much less efficient than bulls even when the cost of maintenance is removed. This indicates that there is more difference between males and females in efficiency than can be accounted for by differences in rate of gain. Thus, one would suspect either a difference in basal metabolism with heifers much higher or a difference in material stored in the body with bulls showing more protein and water storage and heifers having more fat deposition.

20. There are marked animal differences in response to weaning. Some calves had regained all lost weight in a few days, whereas others required over two weeks to recover.

21. Normal volume of urine excreted during a 24-hour period is presented for calves at 500 and at 800 pounds body weight in Table 7.

Table 7. Total Urine Excretion Per Calf During 24 Hours by Experimental Groups at 500 and at 800 Pounds Body Weight.

Group	cc. of Urine Excreted/24 Hours 500 lbs. Calves	Ave.	High	Low	800 lbs. Calves	Ave.	High	Low
All animals	24	3472	7100	1815	41	6992	12025	3525
All males	10	3439	7100	1815	17	6689	9100	4350
All females	14	3496	5400	2320	24	7260	12025	3525
All Herefords	18	3597	7100	1815	25	6908	10050	3525
All Angus	6	3098	4500	2320	16	7123	12025	4725

22. Excretion of nitrogen through the urine during a 24-hour period for calves at 500 and at 800 pounds body weight is presented in Table 8. It can be seen that nitrogen excretion was about double at 800 pounds that at 500 pounds body weight.

Table 8. Urinary Nitrogen Excretion Per Calf Per Twenty-Four Hours by Experimental Groups at 500 and at 800 Pounds Body Weight.

	Nitrogen Excreted (gm./24 hours)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	24	46.19	81.54	19.40	41	97.20	165.70	46.50
All males	10	36.75	53.18	19.40	17	84.31	115.78	46.50
All females	14	53.60	81.54	38.22	24	106.43	165.70	75.38
All Herefords	18	45.55	81.54	19.40	25	96.10	165.70	46.50
All Angus	6	48.19	58.77	32.66	16	99.00	135.90	49.08

23. Excretion of nitrogen during 24 hours per kilo body weight is shown in Table 9 for calves at 500 and at 800 pounds body weight. It can be seen that there was an increase in nitrogen excretion which may reflect a reduction in nitrogen storage of the larger animals. Bulls, which are growing more rapidly, excreted much less urinary nitrogen than heifers.

Table 9. Urinary Nitrogen Excretion Per Kilo Body Weight of Calf Per 24 Hours By Experimental Groups at 500 and at 800 Pounds Body Weight.

	Nitrogen Excretion (mg./kilo)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	21	234	411	154	41	273	453	129
All males	7	187	258	154	17	234	324	129
All females	14	258	411	179	24	300	453	224
All Herefords	15	235	411	158	25	269	453	129
All Angus	6	232	283	154	16	279	384	137

24. Urinary urea excretion per 24-hour period is presented in Table 10 for calves at 500 and at 800 pounds body weight. Males had much lower urinary urea excretion than females and since their rate and efficiency of gains were greater than that of females, it may be assumed that the difference in nitrogen metabolism of the two sexes is associated with differences in feed efficiency.

Table 10. Urinary Urea Nitrogen Excretion Per Calf Per 24 Hours by Experimental Groups at 500 and at 800 Pounds Body Weight.

	Urea Nitrogen Excretion (gm.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	25	27.90	59.89	5.86	41	79.90	147.97	19.07
All males	11	17.83	41.82	5.86	17	65.31	101.29	20.20
All females	14	35.81	59.89	17.76	24	90.24	147.97	19.07
All Herefords	19	26.77	59.89	5.86	25	77.36	147.97	19.07
All Angus	6	31.18	53.51	12.82	16	83.86	124.08	38.11

25. Urinary urea excretion per kilo of body weight is shown in Table 11 for calves at 500 and at 800 pounds body weight. It can be seen from Tables 10 and 11 that urea excretion increased as the calves went from 800 pounds body weight. Since feed efficiency decreased as calves increased in body weight it may be that this supports the contention that greater urea excretion is associated with reduced efficiency.

Table 11. Urinary Urea Nitrogen Excretion Per Kilo Body Weight of Calves Per 24 Hours By Experimental Groups at 500 and at 800 Pounds Body Weight.

	Urea Nitrogen Excretion (mg/kilo)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	21	152	302	41	41	216	404	54
All males	7	104	203	41	17	163	282	80
All females	14	176	302	59	24	254	404	54
All Herefords	15	143	302	41	25	204	404	54
All Angus	6	175	258	84	16	236	344	106

26. Urinary creatinine excretion per 24-hour period is presented in Table 12 for calves at 500 and at 800 pounds body w eight. It can be seen that all calves excreted more creatinine at 800 than at 500 pounds body weight. Also one notes a higher excretion of creatinine in males than in females.

Table 12. Urinary Creatinine Excretion Per Calf Per 24 Hours By Experimental Groups at 500 and at 800 Pounds Body Weight.

	Creatinine Excretion (gm.)							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	25	6.32	9.92	3.20	41	8.99	13.62	4.46
All males	11	6.82	7.59	5.89	17	9.55	13.62	4.46
All females	14	5.93	9.92	3.20	24	8.59	10.89	5.22
All Herefords	19	6.5[illegible]	9.92	3.20	25	9.11	1[illegible].62	5.43
All Angus	6	5.47	7.56	3.81	16	8.80	11.36	4.46

27. The urinary creatinine excretion in mg./kg. body weight (creatinine coefficient) for calves at 500 and at 800 pounds body weight is presented in Table 13. The creatinine coefficients decreased from 500 to 800 pounds body weight. Bulls had a higher creatinine coefficient than heifers at both weights.

Table 13. Creatinine Coefficients of Groups of Experimental Calves at 500 and at 800 Pounds Body Weight.

	Creatinine Coefficient							
	500 lbs.				800 lbs.			
Group	Calves	Ave.	High	Low	Calves	Ave.	High	Low
All animals	21	11.00	18.18	5.82	41	9.39	14.21	4.51
All males	7	11.96	18.88	10.12	17	9.88	14.21	4.51
All females	14	10.52	17.12	5.82	24	9.04	11.32	5.37
All Herefords	15	11.51	18.88	5.82	25	9.49	14.21	5.82
All Angus	6	9.74	13.29	6.69	16	9.23	11.86	4.51

28. The calves on test in 1953 made good gains and efficiencies and only in the Angus were abnormals detected.

Table 14. Rate and Efficiency and Age at 500 Pounds for Calves by Lines and Sexes.

Lines	Sexes	No. of Animals	Age at 500 lbs. in days	Ave. Daily Gain on test in lbs/day	Feed/100 lbs. gain in TDN
1	Males	8	233	3.12	372
1	Females	4	229	2.37	526
2	Males	3	220	2.43	404
2	Females	4	265	2.20	497
3	Males	1	246	2.75	396
3	Females	6	254	2.26	528
4	Males	6	215	2.87	404
4	Females	11	264	1.95	608

29. Calves that are born dead or have died soon after birth have been examined for skull defects. Two calves in the Herefords showed hydrocephalus conditions and would under ordinary range conditions have been missed.

30. The individual record of calves feed tested are presented:

Lionheart Line

No.	Suckling gain in lbs./day	Rate of gain on test in lbs./day	TDN/100# gain	800# score
B1	2.30	2.45	417	88.0
B4	1.74	3.26	338	85.3
B8	1.87	3.09	330	84.5
B11	1.74	2.57	445	86.1
B13	1.92	2.83	364	89.4
B16	2.45	2.72	366	83.7
B20	1.63	3.50	322	86.4
B21	1.70	3.05	361	86.3
B22	1.67	3.19	320	85.4
B27	1.86	2.26	521	85.8
B28	1.91	3.28	326	83.5
B32	1.97	2.20	545	79.0
C2	2.07	1.96	611	89.4
C15	2.07	2.63	467	83.6

Prince Line

B2	1.63	2.05	537	82.7
B7	1.49	2.27	453	79.2
B10	1.36	2.33	403	78.5
B15	1.93	1.90	431	77.5
B18	2.69	2.80	304	86.8
B26	2.26	2.17	402	84.7
B29	1.78	2.57	397	83.5
C16	2.63	2.92	406	84.6
C8	2.09	2.58	429	83.9
C19	2.01	2.35	454	82.9

David Line No.	Suckling gain in lbs./day	Rate of gain on test in lbs./day	TDN/100# gain	800# score
B5	1.76	2.27	495	82.2
B6	1.82	2.21	483	87.3
B9	1.40	2.23	515	82.0
B12	1.70	2.75	363	75.5
B17	1.44	2.28	473	82.8
B19	1.90	2.14	470	84.1
B25	1.87	2.41	464	84.3
C4	1.89	2.41	466	83.5
C10	2.02	2.69	443	85.6
C12	2.43	2.44	493	77.2
C1	1.69	2.29	547	86.5
Angus				
B50	1.99	1.90	528	79.4
B51	2.47	2.99	331	76.8
B53	1.56	2.18	512	74.4
B58	1.74	2.00	551	78.9
B59	1.36	1.81	622	75.3
B64	1.80	1.97	555	79.3
B65	1.83	1.85	559	83.1
B69	1.75	2.55	470	80.3
B52	1.68	1.68	743	79.6
B55	2.35	3.65	298	78.2
B56	2.24	2.38	402	82.6
B57	2.07	3.05	365	81.5
B60	1.92	2.64	418	83.4
B61	1.52	2.01	588	78.9
B63	1.82	2.50	411	79.9
B66	1.64	1.64	581	84.5
B68	1.65	1.88	541	80.1
C60	2.51	2.61	466	
C55	1.93	2.06	550	86.0
C56	1.91	2.53	477	78.9
C50	2.18	1.84	533	85.1
C59	2.07	2.23	484	82.5

An undiagnosed disease resulted in the death of 3 heifers assigned to ration 1 and 4 animals assigned to ration 2 during the test periods. A total loss of over 20 animals from the entire 1952 Squaw Butte calf crop was believed to have been due to the same disease. An intensive study of the disease situation by the Veterinary Diagnostic Laboratory of Oregon State College and the State Department of Agriculture failed to disclose the reason for the severe loss.

The disease, in nearly all cases, started with various degrees of scouring and then progressed to the more acute stages. It is possible that unrecognized forms of the disease might have affected the surviving animals' growth response. Because of this possibility it is believed that unreliable conclusions might be drawn from the interpretation of the "rate of gain" and "feed efficiency" data

collected during 1952-53. It is possible that the data will prove valuable at a later date in demonstrating how unrecognized environmental factors can result in false conclusions on such a study.

This disease prevented reliable results from feed testing also.

At the Eastern Oregon Station

31. Stall feeding results, 1952-53:

120-day Test Period	Gain Per Day	TDN/100 lbs. Gain
Highest bull	3.04	364.3
Lowest bull	1.92	522.9
Highest heifer	2.38	443.8
Lowest heifer	1.50	619.7

32. Lot feeding results, 1952-53:

Two lots of steers were full fed to study the effects of replacing 1/3 of a straight wheat concentrate with cull peas.

Ration (150-Day Test Period)	Ave. Gain/Day	Ave. TDN/100 lbs. Gain
Lot 1 - 10 head steers Chopped alfalfa-grass hay, wheat and silage	1.92	712.4
Lot 3 - 10 head steers Chopped alfalfa-grass hay, wheat 2/3, peas 1/3, and silage	2.06	683.2

33. Two lots of heifers were fed on a continuation of the study of the effects of a complete mineral supplement vs. no mineral on rate and efficiency of gain.

Ration (150-Day Test Period)	Ave. Gain/Day	Ave. TDN/100 lbs. Gain
Lot 5 - 10 head heifers Chopped alfalfa-grass hay, wheat 2/3, peas 1/3, silage, mineral	1.65	700.4
Lot 4 - 10 head heifers Chopped alfalfa-grass hay, wheat 2/3, peas 1/3, silage	1.79	754.3

34. Two lots of steers were fed to compare the value of two different amounts of silage in the fattening ration. Steers on 10 pounds silage per head per day gained .11 pound less per day than those on 5 pounds silage. The small difference in TDN consumed per 100 pounds gain, 9 pounds, was in favor of the lesser amount of silage.

Ration (150-Day Test Period)	Ave. Gain/Day	Ave. TDN/100 lbs. Gain
Lot 2 - 10 head steers Chopped alfalfa-grass hay, wheat 2/3, peas 1/3, silage 10 pounds	1.95	692.2
Lot 3 - 10 head steers Chopped alfalfa-grass hay, wheat 2/3, peas 1/3, silage 5 pounds	2.06	683.2

35. Improvement has been made in rate and economy of gains in all four lines in the one generation of cattle covered by the Oregon Station even though inbreeding approaching that of half-sib matings has been practiced. The progress in rate of gain has been more striking than that in feed efficiency.

Average Initial Rate of Gain and Feed Efficiency Compared With the Present for the 4 Lines of Cattle at the Oregon Station Along With Present Inbreeding.

Line	Rate of Gain		Feed Efficiency*		1952-53 Inbreeding %
	Initial	1952-53	Initial	1952-53	
Angus - Bulls	2.51	2.87	400	371	10.5
Heifers	1.78	2.13	565	559	
Lionheart - Bulls	2.30	3.12	460	341	9.9
Heifers	1.70	2.34	572	505	
Prince - Bulls	2.35	2.43	366	370	8.4
Heifers	1.94	2.20	480	455	
David - Bulls	2 17	2.75	428	363	16.7
Heifers	1.95	2.26	500	483	

36. The registered line of Herefords at the Eastern Oregon Station has continued to improve in production while being handled under Eastern Oregon Range conditions. This, plus the significant regression of economy of gain on rate of gain, indicates that a rancher in Eastern Oregon can improve both rate and efficiency by weighing calves at birth and weaning and selecting accordingly, with very little change in his methods of operation.

37. The administration of testosterone increased the rate and economy of gains particularly in heifers. This indicates that with the use of the hormone more beef could be produced with less feed. Two studies are needed, however, to make this practical. One must first know that the hormone in the beef cattle is eliminated prior to slaughter so no harm will come to people eating the meat. The hormone must be administered in a form and way that will require the minimum of handling the animals. There is evidence that this hormone increases bone growth and nitrogen and water retention which means more muscle but reduces fat storage. From the standpoint of present human needs for more protein and less fat, one might see a real place for use of testosterone in the cattle fattening program.

38. Procedures have been worked out which are being put into practice by ranchers with the help and guidance of the Extension Service which are giving marked improvement in beef cattle production.

*TDN per 100 lbs. gain

39. Several of the factors which influence feedlot or test performance have been studied so that we now know which ones influence performance most and can do all possible to standardize our test program properly as the dairy people have done in their dairy herd improvement work. It appears now that the adjustment period of about a month between weaning and feed testing allows the test to be made with the minimum of pre-influence affecting it.

40. Many practical applications of results may be made of the material that has been put out in published form. One unpublished indication arising from results of the 3 stations - one using roughage with only a bare amount of concentrate, one using 2 parts good alfalfa hay to one part of concentrate and the other using heavy concentrate-to-hay feeding. It appears that selection for the best doing animal in each group leads to improvement. This shows the fact that selections for good feedlot performance can be made on a ration which will not be injurious to future production of the bulls and heifers because of overfatness.

41. Rabbits given testosterone gained more rapidly and required less feed per unit of gain whereas those animals receiving estrogens gained at a slower rate and required more feed per unit of gain than the control rabbits.

Table 1. Effect of Sex Hormones on Gains, Efficiency and Dressing Percentage of Rabbits.

Treatment	Gain/Day (Gms)	Feed Eaten/Day (Gms)	Feed/Unit Gain	Dressing Percent
Control	22.8	216.5	9.5	59.3
Testosterone	23.9	221.5	9.4	59.3
Estradiol	22.0	215.3	9.8	57.7
Stilbestrol	18.9	198.5	10.7	59.1

42. Dressing percent was not altered by testosterone administration but was lowered by estradiol (Table 1).

43. Meat from animals receiving testosterone had a greater cooking loss than meat from control rabbits. Meat from animals receiving estradiol had less shrinkage during the cooking than meat from control rabbits (Table 2).

Table 2. Effect of Sex Hormones on Cooking Losses.

Treatment	Drip loss in %	Evaporation loss in %	Total cooking loss in %
Control	2.66	16.15	18.84
Testosterone	2.57	17.16	19.75
Estradiol	1.96	14.41	16.38
Stilbestrol	2.54	15.60	18.14

44. Carcass composition was altered by the sex hormones. Administration of testosterone resulted in more protein in the lean portion of the carcass without altering the fat in the lean or muscle. Stilbestrol, on the other hand, brought about a reduction in fat in the lean part of the animal although total fat of the animal was higher than for control or testosterone-treated animals (Table 3).

Table 3. Effect of Sex Hormones on Chemical Composition of the Lean Portion of the Carcass.

Treatment	Dry matter in %	Ether Extract in %	Crude protein in %
Control	27.23	11.52	82.33
Testosterone	27.02	11.74	85.39
Estradiol	27.29	11.30	84.48
Stilbestrol	27.15	9.37	83.21

45. The effect of sex of rabbit and whether castrate or intact seemed to be unimportant factors influencing chemical composition of the lean portion of the carcass (Table 4).

Table 4. Effect of Sex of Rabbit and Hormone Treatment on Chemical Composition of Lean Portion of Carcass.

Treatment	Sex	Dry Matter	Ether Extract	Crude Protein
	Intact female	27.87	13.90	83.56
	Castrate female	27.44	12.97	81.52
Control	Intact male	26.83	8.52	85.57
	Castrate male	26.77	10.70	78.78
	Average	27.23	11.52	82.33
	Intact female	27.17	14.37	86.21
	Castrate female	26.94	11.49	85.35
Testosterone	Intact male	27.01	9.64	83.90
	Castrate male	26.97	11.45	86.10
	Average	27.02	11.74	85.39
	Intact female	27.12	12.47	83.85
	Castrate female	28.20	13.43	81.92
Estradiol	Intact male	26.89	10.36	87.16
	Castrate male	26.97	8.94	84.98
	Average	27.29	11.30	84.48
	Intact female	27.43	9.70	81.80
	Castrate female	27.43	10.73	81.16
Stilbestrol	Intact male	26.72	8.18	86.19
	Castrate male	27.01	8.88	83.71
	Average	27.15	9.37	83.21

46. Hormone administrations and sexes of the rabbits had little or no effect on the percent of dry matter or the ether extract of the fat portion of the carcass. The fat portion of the carcass was almost entirely composed of fat (Table 5).

Table 5. Effect of Sex of Rabbit and Hormone Treatment on Chemical Composition of Fat Portion of Carcass.

Treatment	Sex	Dry Matter %	Ether Extract %
	Intact female	96.18	99.66
	Castrate female	94.75	97.91
Control	Intact male	96.13	98.35
	Castrate male	95.03	99.33
	Average	95.52	98.81

Table 5. Effect of Sex of Rabbit and Hormone Treatment on Chemical Composition of Fat Portion of Carcass. (Continued)

Treatment	Sex	Dry Matter %	Ether Extract %
	Intact female	95.67	97.40
	Castrate female	95.74	99.27
Testosterone	Intact male	96.04	99.47
	Castrate male	96.69	99.49
	Average	96.00	98.91
	Intact female	96.37	99.10
	Castrate female	94.70	98.78
Estradiol	Intact male	96.10	99.78
	Castrate male	94.34	98.19
	Average	95.38	98.96
	Intact female	96.57	99.38
	Castrate female	94.75	98.95
Stilbestrol	Intact male	95.41	96.63
	Castrate male	96.19	99.62
	Average	95.73	98.65

47. Cooking losses from evaporation was least in carcasses from intact females and most for intact males (Table 6). There appears to be slightly less evaporation loss during cooking where the fat content is highest in the lean portion of the carcass (Tables 5 and 6).

Table 6. Effect of Sex of Rabbit and Hormone Treatment on Cooking Losses.

Treatment	Sex	Drip Loss %	Evaporation Loss %	Total Cooking Loss %
	Intact female	2.37	11.64	14.01
	Castrate female	3.60	17.15	20.75
Control	Intact male	2.12	17.16	19.38
	Castrate male	2.56	18.67	21.23
	Average	2.66	16.15	18.84
	Intact female	1.95	14.96	16.91
	Castrate female	2.92	16.47	19.49
Testosterone	Intact male	2.80	18.48	21.28
	Castrate male	2.60	18.74	21.34
	Average	2.57	17.16	19.75
	Intact female	2.58	14.54	17.12
	Castrate female	2.43	14.69	17.12
Estradiol	Intact male	1.51	13.17	14.68
	Castrate male	1.33	15.26	16.59
	Average	1.96	14.41	16.38
	Intact female	2.88	13.55	16.43
	Castrate female	2.38	14.60	16.98
Stilbestrol	Intact male	2.37	19.11	21.48
	Castrate male	2.55	15.14	17.69
	Average	2.54	15.60	18.14

48. Females had a higher dressing percent than males. Castrate males were higher in dressing percent than intact males. Also, castrate females receiving estrogens dressed a higher percent than corresponding intact females (Table 7).

49. There appeared to be little relation of rate or efficiency of gain with dressing percent.

50. Females responded to testosterone treatment to a greater extent in rate and efficiency of gains than males (Table 7).

Table 7. Effect of Sex of Rabbit and Hormone Treatment on Gain, Efficiency, and Dressing Percentage.

Treatment	Sex	Mean Wt. Live Animal Before Slaughter (Gms.)	Mean Wt. Dressed Carcass (Gms.)	Dressing Percent	Gain/Day 1st Period (Gms.)	Food/Day 1st Period (Gms.)	Efficiency of Gain (g./g.)
	Intact female	4399	2671	60.73	21.99	217.8	9.91
	Castrate female	3889	2369	60.92	21.36	202.7	9.49
Control	Intact male	3945	2249	57.02	21.52	205.5	9.55
	Castrate male	4629	2715	58.65	26.35	240.1	9.11
	Average	4215	2501	59.3	22.8	216.5	9.5
	Intact female	4702	2822	60.01	26.38	230.3	8.73
Testos-	Castrate female	4413	2665	60.38	27.16	224.6	8.27
terone	Intact male	4366	2502	57.31	20.41	215.9	10.58
	Castrate male	4535	2648	58.38	21.64	215.0	9.93
	Average	4504	2659	59.3	23.9	221.5	9.4
	Intact female	4830	2885	59.11	21.63	225.2	10.41
Estrad-	Castrate female	4204	2554	60.74	21.83	215.2	9.86
iol	Intact male	3986	2241	56.21	20.99	202.6	9.65
	Castrate male	3909	2144	54.84	23.55	218.4	9.27
	Average	3386	2448	57.7	22.0	215.3	9.8
	Intact female	4585	2687	58.60	20.50	216.9	10.58
Stilbes-	Castrate female	4213	2565	60.88	16.73	201.3	12.03
trol	Intact male	3771	2165	57.41	15.18	172.2	11.35
	Castrate male	4316	2558	59.27	23.11	203.7	8.82
	Average	4221	2494	59.1	18.9	198.5	10.7

51. Estrogens and androgens both caused a marked reduction in ovarian and testicular weights. Estradiol was more harmful to both the ovaries and the testes than testosterone or stilbestrol (Table 8).

52. Castrate females had smaller adrenal glands than males or intact females (Table 8).

53. Generally speaking, the adrenals from animals receiving estrogen were larger than from control or testosterone-treated animals (Table 8).

54. Pituitary glands from intact males were much smaller than from castrate males or from females (Table 8). In fact, castrate males had very large pituitary glands (Table 8).

55. Testosterone and stilbestrol appeared to stimulate larger size of pituitaries (Table 8).

56. Thyroid glands were much smaller from rabbits receiving stilbestrol (Table 8).

57. Liver weights were quite variable and apparently not associated with hormone treatment (Table 8).

Table 8. Effect of Sex of Rabbit and Hormone Treatment on Weight of Some Endocrine Organs and the Liver.

Treatment	Sex	Mean Wt. of Liver (Gms.)	Mean Wt. of Thyroid (Mg.)	Mean Wt. of Pituitary (Mg.)	Mean Wt. of Adrenals (Mg.)	Mean Wt. of Testicles (Gms.)	Mean Wt. of Ovaries (Mg.)
	Intact female	91.0	411	31.58	352.6		417
	Castrate "	73.0	390	33.18	287.4		
Control	Intact male	83.0	451	25.33	413.1	6.62	
	Castrate "	105.0	466	34.70	430.7		
	Average	88.0	429	31.20	371.0	6.62	417
	Intact female	85.8	363	36.88	336.6		311
Testos-	Castrate "	89.3	432	40.00	327.7		
terone	Intact male	109.0	384	23.58	331.2	3.76	
	Castrate "	92.8	449	42.53	360.9		
	Average	94.2	407	35.74	339.1	3.76	311
	Intact female	93.0	574	30.0	316.7		233
Estrad-	Castrate "	71.8	420	31.58	329.9		
iol	Intact male	73.0	351	26.68	526.3	2.04	
	Castrate "	71.8	456	37.40	459.1		
	Average	77.4	450	31.41	408.0	2.04	233
	Intact female	89.8	357	33.18	437.0		336
Stilbes-	Castrate "	74.3	337	42.08	327.5		
trol	Intact male	86.8	345	27.35	412.1	3.88	
	Castrate "	76.3	400	40.35	378.2		
	Average	81.8	360	35.74	388.7	3.88	336

58. Rats four weeks of age were fed a ration composed mostly of rabbit meat. Male rats were castrated at the start of the experiment. Three to four rats were assigned to each treatment. Rats were weighed at the start of the experiment and at six-day intervals for 19 days. At the end of the experiment, they were killed. In the males, measurements of the prostate, ampulae, seminal vesicles and penis were taken. In the females, measurements of the vagina and uterine horns were taken and the number of corpora lutea in both ovaries was counted.

From the above results, it seems that there is no indication that meat from rabbits treated with the above-mentioned hormones retained a detectable amount of hormones.

59. Calves receiving a single large dose of highly potent testosterone preparation either in oil or aqueous solution gain more rapidly and economically than controls for a period but it appears that this effect starts diminishing in 30 to 50 days. Thus, more than injection is needed or some other type of hormone material is needed.

V. Work Plan for the Future:

1. Obtain photographs, scores and measurements on each calf at 500 pounds when it goes on feed test and at 800 pounds when it comes off feed test in both the Hereford and the Angus herd.

2. Individually feed all calves produced in the purebred Hereford and Angus herd recording rate of gain and feed consumed from 500 to 800 pounds weight.

3. Cooperate with breeders both as individuals and as groups in keeping records to help in selection and in their feed testing programs.

4. Continue the work on the use of rabbits and other laboratory animals as pilot animals in various genetic and physiology studies that may later be applied to beef cattle improvement.

5. Analyze data and determine heritability on the selection index used at the Oregon Station. Determine if possible if the relative proportion allotted to each of the four characteristics for which selection is practiced is justified.

6. Make matings to continue the three sub-lines of Herefords and one line of Angus.

7. Cooperate to the fullest extent with the branch stations, particularly in the analysis of data and in the making of breeding material available to them.

8. Complete the study on factors affecting response of calves to weaning and the relation of this response to pre-and post-weaning performance.

9. Complete the study on changes in constituents of the blood as it is related to rate and efficiency of production.

10. Complete the study on changes in body measurements and blood constituents associated with the development of the animal.

11. Determine digestibility of each animal put through the feed test and see what part of the rate and efficiency of gain variation is accounted for by differences in digestibility.

12. Determine the normal physiology of the beef animal such as respiration rate, heart rate, blood pressure, and some other physiological characteristics and see if age, season and sex influence these. Determine from figures already obtained if these physiological functions are closely related to rate and economy of gains.

13. Complete the study on net efficiency and factors that affect it.

14. Emphasis will be placed this year on analyzing and publishing results up to project plan revision since there will be some shift in emphasis of the project.

15. Publication of a summary of the work on the beef cattle project at this station will be pursued.

16. Increase the concentrate portion of ration 1 to 2 pounds of barley and 1 pound of cottonseed meal.

17. Full-feed both mixed hay (1/2 meadow hay - 1/2 alfalfa) and concentrate on ration 2 rather than restricting to a 1:1 ratio.

18. Haul all heifers to summer range rather than trail.

19. Weigh a t least every 14 days during winter.

20. All grade cows will be mated in one-sire blocks to index selected bulls produced by registered cows.

21. All registered cows will be bred to index selected bulls whose progeny have completed stall tests or lot feeding tests.

22. The wintering phase on calves now on this test will be continued until pastures are ready to graze this spring, at which time all wintered calves except those on maximum gain will be weighed from the lots to pasture and the test will be continued until market time in the fall.

23. Cost of production will be determined on all calves and thus the most efficient level of winter feeding determined.

24. Beginning fall of 1954 this procedure will again be followed at least one more year.

25. The system of records now in use will be continued.

26. Selection of sires for use will be continued on an index basis.

27. This spring, individual weights will be taken on all cows and calves when they are turned to summer range or station pasture.

28. The work program for next year calls for a duplication of the rabbit work using smaller and younger rabbits to see the effects of these hormones while the animals are still in the straight line growth phase.

29. The residual hormones in meat from treated animals will be thoroughly studied.

30. Development of a method for administering testosterone without the need for weekly injections will be attempted.

31. The use of testosterone in old cows and in poor doing animals will be studied to see if it has general anabolic properties. Some human studies would indicate this. Other hormones such as the adreno corticotrophic, gonadotrophic and pituitary growth hormones will be studied.

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BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

State Oregon
Date 6/22/54

I. Cattle Inventory

	A. Purebreds					B. Grades	
Line designation	Lionheart	David	Prince	Angus	Union		
Breed	Hereford	Hereford	Hereford	Angus	Hereford	Hereford	Hereford
Station	Central	Central	Central	Central	Eastern Oregon	Union	Squaw Butte
Bulls (12 mo. or over)	3	3	8	3	3	5	2
Cows (2 yrs. or over)	15	14	16	24	27	80	30
Heifers, yearling	4	4	2	4	9	10	12
Male calves	6	6	8	8	11	36	14
Heifer calves	6	4	4	10	12	38	12
Percentage use for breeding project	50	50	50	50	100	20	100
Estimated cash value	$13,000	10,000	10,000	17,000	20,000	18,000	10,000

II. Young animals which were on feed during 1953-54.

A. Purebreds

	Herefords			Angus		Shorthorns	
	Number Individually Fed		Number Group Fed	Number Individually Fed	Number Group Fed	Number Individually Fed	Number Group Fed
	Corvallis	Union					
Bulls	19	9	0	1	0	0	0
Heifers	16	8	0	8	0	0	0
Steers			0	7	0	0	0

B. Grades

		Union				
Bulls	0	0	0	0	0	0
Heifers	0	9	0	0	0	0
Steers	0	60	0	0	0	0

III. Additions of land, physical facilities and equipment during fiscal year 1953-54.

Item	No.	Actual Cash Value	Percentage use for beef breeding project
Self feeding silo	1	$6,500	50

IV. Funds expended during fiscal year 1953-54 (make estimates for remainder of year).

Source	Amount Non-recurring items	Amount Operating Expense
9b3	0	$8,000
BAI funds	0	3,600
State-controlled funds	0	Union-$7,000; Squaw-Bute-$5,000; Central-$13,000
Gift (Schering Corporation)		3,500

U. S. Range Livestock Experiment Station

I. Station: U. S. Range Livestock Experiment Station, Miles City, Montana.

II. Titles of Current Projects (Beef Cattle Breeding):

b-4-1-3 Testing methods of measuring performance in beef cattle under farm and range conditions.

b-4-1-6 Development of superior strains of Hereford cattle.

III. Personnel: J. R. Quesenberry, R. R. Woodward and C. E. Shelby.

IV. Work Progress:

The growth a nd carcass data obtained from ten years of progeny testing was analyzed and is being published as a U. S. Department of Agriculture Technical Bulletin and in popular form as a Montana Agricultural Experiment Station Circular. Heritability estimates of various characteristics were also made from these data as a supplement to previous estimates made from a less controlled population.

Records of all cows, bulls and progeny test steers that have been in the station herd in past years are being placed on IBM cards. This work has been supplemental to the transfer of current records.

Two new lines were added to the station herd during the past year. Line 7 was discarded because of low production. The lines as established for the 1954 breeding season are as follows:

Line Designation	Line of 1954 Sire	No. of Cows in Line	Source of Line
L1A	1	31	Two Advance Domino bulls bred to unrelated cows.
L1B	1	31	Two Advance Domino bulls bred to unrelated cows.
L1C	1	30	Two Advance Domino bulls bred to unrelated cows.
L1D	1	31	Two Advance Domino bulls bred to unrelated cows.
L1E	10	30	Two Advance Domino bulls bred to unrelated cows.
L4A	4	22	Husker Mischief bulls x Husker Mischief cows.
L4B	4	22	Husker Mischief bulls x Husker Mischief cows.
L5	5	32	Young Mischief bulls x Young Mischief cows.
L6	6	29	Real Prince Domino bulls x Real Prince Domino cows.
L8	8	18	Evan Mischief bulls x Evan Mischief cows.
L9	9	34	King Domino bulls x King Domino cows.
L10	10	30	Errol Domino bulls x Errol Domino cows.

Line Designation	Line of 1954 Sire	No. of Cows in Line	Source of Line
L11	1	19	Reciprocal cross, Line 1 x Line 5.
L12	12	17	Line 10 bull x Line 1 cows.
L13	13	17	Brae Arden bulls x Brae Arden cows.

Line 12 was formed this year from a Line 10 x Line 1 cross which exceeded the parental lines in practically all production factors. Line 13 was acquired from the Brae Arden Hereford Ranch at Laramie, Wyoming.

The outstanding performance record of the bulls fed this year was again made by calves from Line 11 (Reciprocal cross of Line 1 x Line 5). One of the Line 1 sublines performed almost as well, however. The relative rank between lines remained about the same. The herd sires of L1B and L9 were replaced this year as they both had sons with superior performance records.

Bulls from the following lines were placed in breeding herds for progeny tests this year:

Herd Designation	Line of Sire	No. of Cows in Test Herd	Reason for Testing
T1	L1D	33	Progeny test sub-line.
T2	L1D	33	Progeny test sub-line.
T3	L1D	33	Progeny test sub-line.
T4	L13	34	New line.
T5	L4	34	Check against Line 1 control.
T6	L5	34	Check against Line 1 control.
T7	L6	34	Check against Line 1 control.

One of the sublines of Line 1 (L1D) has been designated to test rate of improvement through selection on the basis of a progeny test as opposed to improvement through selection on the record of the sire. Line 1 has been used as a control line each year during the testing program.

The station is cooperating in the accumulation of profile data by obtaining annually the profiles of all yearling bulls as they finish the production test at about 13 months of age. All cows in the station herd, with the exception of those in the grazing experiment were profiled in the fall of 1953. Blood samples were obtained from both cows and bulls for blood typing studies being conducted in cooperation with the University of Wyoming.

V. Future Work Plans: Present plans are to continue existing projects approximately as they are now in progress. Additional work is contemplated in the study of fertility and calving losses within the lines.

VI. Publications:

Relationships between Pre-Slaughter and Post-Slaughter Evaluations of Beef Cattle, U.S.D.A. Technical Bulletin (being printed).

Production and Carcass Quality in Beef Cattle, Montana Experiment Station Circular (being reviewed).

The Heritability of Some Economic Characteristics of Beef Cattle (being reviewed).

VII. Animal Inventory:

Females	
Cows	824
Yearling heifers	272
Calves	257
Males	
Bulls	32
Yearling bulls	23
Calves	171
Steers	
2 yr. old steers	119
Yearling steers	187
Steer calves	74
Total	1,959

Discussion by Technical Committee:

Dr. Shelby discussed the current analysis of station data. The IBM facilities at Denver were used for the analysis which included data from 635 steers over a ten-year period. A preliminary study of the analysis gave these heritability estimates: Birth weight, 72; weaning weight, 30; gain on test, 60; final weight, 84; efficiency of gain, 22; slaughter grade, 42; shrink, 91; dressing percent, 73; carcass grade, 16; color of rib eye, 31; area of rib eye muscle, 72; thickness of fat over rib eye, 38.

Dr. Woodward stated that there was serious consideration being given to discarding poor performing lines at that station. New lines were to be acquired when suitable foundation animals were found. He then gave a brief review of the results of carcass studies of steer progeny. Birth weight was more highly indicative of future rate of gain than it was of carcass quality. Growth prior to weaning was not very highly indicative of performance in the feed lot. There was some degree of correlation between weaning weight and carcass grade. Rate of gain was positively correlated but to a very minor degree with carcass grade. Efficiency had little correlation with any of the other factors. Grade just prior to slaughter showed a correlation with carcass grade of about .5. The greatest reason for error in grading on the hoof as compared to carcass grade was apparently due to the wide variation in area of lean which contributed so highly to the carcass grade. Carcass grade was correlated with area of rib eye but not as highly as was rib eye with fat covering. Dressing percentage was correlated with carcass grade and rate of gain.

Utah

I. Station: Utah Agricultural Experiment Station, Logan, Utah.

II. Title of Project: The Improvement of Beef Cattle Through the Application of Breeding Methods.

III. Personnel: James A. Bennett, Doyle J. Matthews, Ted Bateman, A. J. Nyman, Owen Asplund.

IV. Progress Since Last Report: The development and testing of two lines of Herefords and one line of Shorthorns by a system of mild inbreeding was continued. In one line of Herefords some close inbreeding (sire x daughter, half brother x sister matings) resulted from the use of one sire in the line that was known to be free of the dwarf gene.

Individual feeding tests

Individual feeding tests, for a period of 168 days, were conducted with the sire progeny groups. Nine Hereford and 6 Shorthorn bulls, and 8 Hereford and 4 Shorthorn steers, completed individual feeding tests. In addition, 20 heifers were group fed on a limited grain ration.

Similar differences were found in measures of rate and efficiency of gain as were observed in past years. There was 0.7 pound difference in rate of gain between the fastest and the slowest gaining bull and the most efficient gaining bull gained 5.7 pounds more per 100 pounds of total digestible nutrients consumed than did the least efficient bull. At the Utah Station the length of the test period for the individual feeding trials has been 168 days. Other stations have tested over a 140-day period while still others have used a constant weight gain period, usually from 500 to 800 pounds in weight. Over a period of four years when testing conditions were as uniform as possible, 68 bulls that had completed the 168-day test had also passed from 500 to 800 pounds in weight during the test. It was thus possible to compare the estimations of rate and efficiency as obtained by each of the three methods for each animal. Some bias may be present in these comparisons because the roughage concentrate ratio was varied during the test and all animals were not getting the same ratio at the time they first weighed 500 pounds and for the balance of the period. The error from this source is not thought to be large, however. The results of the analyses are shown in Table II.

Table II. Mean Values and Correlation Values for Different Types of Test Periods.

Character Measured	Mean Values			Correlation Coefficients		
	168 day test	140 day test	500-800 lbs.	168 day x 140 day	168 day x 500-800	140 day x 500-800
Rate of gain	2.34	2.31	2.39	.843**	.784**	.753**
Effic. of gain[1]	22.24	23.12	22.96	.450**	.331**	.701**

[1]Pounds of gain per 100 pounds of T.D.N. consumed.
** Significant at the 0.01 level.

Calving and Weaning Data

A summary of the data collected on calves born in 1953 at the Logan Station shows that the average unadjusted birth weight was 67 pounds for Herefords and 73 pounds for Shorthorns. Average weaning weights (adjusted for age of dam and to a 190-day basis) were 396 pounds for Herefords and 429 pounds for Shorthorns, indicating an advantage of 33 pounds for the Shorthorns. The average daily gain from birth to weaning was 1.73 pounds for Herefords and 1.87 pounds for Shorthorns.

Weaning weight appears to be gradually increasing in the Herefords. Only part of the observed improvement, however, would be expected to be genetic improvement because some selection of cows on the basis of weaning weights of their first two calves has been practiced. Further improvement is desired in the Hereford lines in weaning weight.

Birth weights and seven body measurements and seven body scores have been taken on all the 1954 calves born to date. Average unadjusted birth weights are as shown in Table I for single calves. Three pairs of Shorthorn twins and one Hereford dwarf are not included in the calculations.

Table I. Average Birth Weights of Single Calves Born in 1954.

Breed	Sex	Weight (pounds)
Hereford	Males	73.2
	Females	72.2
Shorthorn	Males	73.9
	Females	72.4

Chromatography Studies

In the spring of 1953, the Utah Station started investigations to determine the value of partition chromatography for classifying cattle as to the presence or absence of the dwarf gene. This work has been actively continued since then and it is felt that some progress has been made although a technique for accurately classifying cattle by this method has not been fully perfected.

Excellent cooperation has been received from other stations and the Regional Coordinator in this work. Blood and urine samples that were supplied to the Utah Station upon request have been very helpful in this work. This cooperation is greatly appreciated.

Principle of Partition Chromatography

Partition chromatography depends upon the difference in solubilities of different substances in each of a pair of partially miscible solvents. In filter paper chromatography, the filter paper serves as a medium for solvent movement. In using chromatography as a means of classifying cattle as dwarf, dwarf-carrier, or dwarf-free, the assumption is made that there is a fundamental difference in the chemical metabolism of the different animals. If the difference is such that different chemical

substances are present in the body fluids, then partition chromatography should illustrate these differences by producing patterns which may be sufficiently different that the classes may be distinguished one from another.

Numerous items influence the degree of success that may be obtained with chromatography. Some of these are: choice of solvents, choice of fluids, fluid sampling technique, chromatography technique.

Choice of Solvents

Many solvent pairs have been tested and a highly suitable pair has been found. The possibility is great, however, that better solvents may be discovered.

Choice of Fluids

To date only blood and urine have been studied and results with urine have been much more encouraging than with blood.

Fluid Sampling Technique

The initial work was done with single urine samples collected at a convenient time. It soon became apparent, however, that the diet of the animal was markedly affecting the appearance of the chromatogram. Fasting the animals for 24 hours prior to collection of the urine sample appears to be desirable.

Tests are now underway to determine if a single collection of urine taken at a particular time of day gives a good indication of the composition of all the urine excreted by an animal. Samples at designated intervals are being compared in composition to 24-hour collections. To date our chromatography work has been based on urine standardized to a constant creatinine bases. Some basic work is needed and is now underway to determine if this is the proper base when only a single collection of urine is to be used.

Chromatography Technique

Many solvent pairs are very unstable and fresh solutions must be used for reliable results. Temperature during development must be carefully controlled to obtain comparable readings.

The ascending or descending method in combination with a one-dimensional or a two-dimensional system may be used. The ascending method has proven most suitable for our studies and our efforts have been concentrated largely on a one-dimensional system thus far.

V. Results: The technique has been perfected to the extent that a high degree of repeatability can now be obtained among chromatograms made at different times from the same urine samples.

Chromatograms produced by urine from dwarf Hereford males have consistently been different from chromatograms from non-dwarf Hereford males. Some

differences between chromatograms from heterozygous Hereford males and homozygous normals have been observed. Most of these appear to be quantitative rather than qualitative differences. There is one spot, however, that appears to represent a qualitative difference. This spot has consistently been present in the normal animal's chromatogram and absent in chromatograms of the heterozygous animals. Another spot has behaved somewhat similarly for most cases but not for all cases. There is a strong possibility that these differences result from different metabolic processes but since the number of proven homozygous-free animals that have been tested is small there is also the possibility that the difference may result from different diets or inherent differences not associated with the dwarf characteristic.

VI. Work Plans for the Future:

A. Future Plans for Chromatography

1. Determine what kind and amounts of fluids are necessary to give reliable measures.

2. Produce chromatograms from proper samples from adequate numbers of animals of known genotypes.

3. If qualitative differences are then found, isolate the substance causing the difference and determine its composition, if possible.

4. Use microbiological assay to study some quantitative differences that appear on the chromatograms.

B. Line Production and Testing

1. Continue to develop the two Hereford and one Shorthorn lines.

2. Individually feed the bull calves as a means of identifying the more rapid and efficient gaining individuals.

3. Collect and analyze birth, weaning and weight data as a means of measuring performance in cows.

VII. Publications and Manuscripts:

Performance testing of beef cattle. (Station bulletin now in manuscript form).

Livestock Inventory (as of June 20, 1954)

Line designation	1	2	3
Breed	Hereford	Hereford	Shorthorn
Station	Panguitch	Logan	Logan
Bulls (12 mo. and over)	5	6	8
Cows (2 yr. and over)	36	30	28
Heifers (yearlings)	9	13	11
Male calves	9	11	12
Female calves	11	13	13
Percentage use for breeding project	100	85	85
Estimated value	$12,100	$13,500	$12,700

Young Animals on Feed 1953-54

	Herefords		Shorthorns	
	No. individually fed	No. group fed	No. individually fed	No. Group fed
Bulls	9		6	
Steers	8		4	
Heifers		10		10

Addition of land, physical facilities 1953-54

Item	No.	Actual Cash value	Percentage use for beef project	Remarks
Irrigated land	14 acres	$8,400.00	75	
Grain storage bins	2	1,615.31	100	
Chromatography apparatus	1	190.00	100	

Funds expended during fiscal year 1953-54

Source	Amount non-recurring items	Amount operating expense
9b3	$ 189.99	$5,310.01
BAI	None	1,800.00
State-controlled funds	1,735.31	11,151.15

Washington

I. Station: Washington Agricultural Experiment Station, Pullman and Prosser, Washington.

II. Title of Project: The Improvement of Beef Cattle Through the Application of Breeding Methods: (a) by moderate inbreeding within the Hereford, Aberdeen-Angus, and Shorthorn breeds; (b) by the testing of inbred sires within the various lines which will be developed.

III. Personnel: M. E. Ensminger, M. W. Galgan, R. E. Christian, C. R. Kyd.

IV. Work Progress:

(1) Raising Beef Calves From Birth

Sixty-two calves from the WSC Hereford, Aberdeen-Angus, and Shorthorn herds were raised without their dams. They were on experiment from birth to 180 days to compare dried whole milk (with and without Terramycin) with synthetic milk (with a nd without Terramycin). The results of this trial are shown in Table I.

TABLE I.

Weights and Feed Consumption of Calves From Birth to 180 days on two kinds of milk, with and without Terramycin

Calf Number	Sex	Breed	Birth Wt.(lb.)	180-day Wt.(lb.)	Aver.Dly Gain (lb.)	Feed/lb. Gain (lb.)	Treatment
40	Male	Hereford	65	335	1.50	3.29	Whole milk No Terramycin
47	"	"	81	345	1.47	3.50	" "
15	"	Angus	53	332	1.55	3.27	" "
21	"	"	64	395	1.84	2.96	" "
62	"	"	62	365	1.68	3.48	" "
64	"	"	50	360	1.72	3.30	" "
18	"	Shorthorn	83	328	1.36	3.63	" "
AVERAGE			65.4	351.4	1.59	3.35	
23	Female	Hereford	70	336	1.48	3.97	Whole milk No Terramycin
10	"	Angus	52	323	1.51	3.23	" "
28	"	"	77	348	1.51	3.94	" "
36	"	"	58	322	1.47	3.29	" "
54	"	"	56	352	1.64	3.55	" "
31	"	Shorthorn	80	325	1.36	4.22	" "
44	"	"	58	300	1.34	4.23	" "
AVERAGE			64.9	340.4	1.53	3.57	

TABLE I. (Continued)

Calf Number	Sex	Breed	Birth Wt.(lb.)	180-day Wt.(lb.)	Aver.Dly Gain (lb.)	Feed/lb. Gain (lb.)	Treatment
22	Male	Hereford	90	350	1.44	3.31	Whole milk plus Terramycin
45	"	"	91	349	1.43	3.43	" "
7	"	Angus	57	355	1.66	3.26	" "
16	"	"	81	363	1.57	3.26	" "
27	"	"	77	415	1.88	3.19	" "
53	"	"	60	375	1.75	3.42	" "
60	"	"	50	345	1.64	3.71	" "
68	"	"	60	356	1.64	3.82	" "
30	"	Shorthorn	70	395	1.81	3.27	" "
37	"	"	83	391	1.71	3.41	" "
AVERAGE			71.9	369.4	1.65	3.41	
63	Female	Hereford	65	345	1.56	3.74	Whole Milk plus Terramycin
11	"	Angus	52	288	1.31	3.48	" "
42	"	"	65	355	1.61	3.76	" "
49	"	"	56	363	1.71	3.30	" "
52	"	"	51	340	1.61	3.64	" "
13	"	Shorthorn	72	305	1.29	4.48	" "
41	"	"	80	350	1.50	4.11	" "
AVERAGE			64.7	352.3	1.51	3.79	
17	Male	Hereford	86	341	1.42	3.54	Synthetic Milk No Terramycin
26	"	"	63	386	1.79	3.20	"
8	"	Angus	53	335	1.57	3.35	"
14	"	"	60	341	1.56	3.31	"
50	"	"	63	420	1.98	3.49	"
58	"	"	53	390	1.87	3.45	"
67	"	"	60	400	1.89	3.95	"
3	"	Shorthorn	53	303	1.39	3.65	"
34	"	"	60	360	1.67	3.19	"
AVERAGE			61.2	364.0	1.68	3.47	
39	Female	Hereford	80	335	1.42	3.78	Synthetic Milk No Terramycin
2	"	Angus	48	283	1.31	3.83	"
66	"	"	48	310	1.46	3.71	"
35	"	"	56	280	1.24	3.47	"
55	"	Shorthorn	84	300	1.20	3.94	"
61	"	"	83	362	1.55	3.80	"
32	"	"	58	295	1.32	3.89	"
AVERAGE			65.3	309.3	1.36	3.77	

TABLE I. (Continued)

Calf Number	Sex	Breed	Birth Wt.(lb.)	180-day Wt.(lb.)	Aver.Dly Gain (lb.)	Feed/lb. Gain (lb.)	Treatment
25	Male	Hereford	76	365	1.61	2.87	Synthetic Milk plus Terramycin
1	"	Angus	46	352	1.70	3.28	"
19	"	"	55	324	1.49	3.54	"
43	"	"	60	365	1.69	3.41	"
56	"	"	73	406	1.85	3.46	"
59	"	"	73	430	1.98	3.54	"
65	"	"	55	380	1.81	3.42	"
29	"	Shorthorn	74	375	1.67	3.54	"
AVERAGE			64.0	374.6	1.73	3.38	
38	Female	Hereford	63	321	1.43	3.56	Synthetic Milk plus Terramycin
57	"	"	57	360	1.68	3.58	"
9	"	Angus	56	321	1.47	3.38	"
12	"	"	56	286	1.28	3.64	"
33	"	"	70	348	1.54	3.43	"
24	"	Shorthorn	64	302	1.32	4.15	"
48	"	"	72	302	1.27	3.98	"
AVERAGE			62.6	319.7	1.53	3.67	

The results for the 180-day period have not been analyzed statistically. Based on the statistical analysis of the 150-day results:

1. There was no significant difference in the rate of gain produced from dried whole milk and synthetic milk.

2. There was no significant difference in the rate of gain between calves receiving Terramycin and those receiving no Terramycin.

3. There was a significant difference in the rate of gain between the sexes, bull calves gaining faster than heifer calves.

(2) Pelleted vs. Non-Pelleted

Thirty-eight calves that were raised without their dams from birth to 180 days, were on experiment from 180 days of age to one-year of age to compare pelleted feeds with ground feeds (with and without Terramycin). The results of this trial are shown in Table II.

TABLE II.

Weights and Feed Consumption of Calves From 180 Days of Age on Pelleted or Unpelleted Ration, With and Without Terramycin

Calf Number	Sex	Breed	180-day Wt.(lb.)	Yearling Wt.(lb.)	Aver.Dly Gain (lb.)	Feed/lb. Gain	Treatment
8	Bull	Angus	335	618	1.53	8.42	Ground no Terramycin
14	Steer	"	341	698	1.93	7.63	"
15	Bull	"	332	680	1.88	7.87	"
21	Steer	"	328	790	2.50	6.47	"
50	"	"	420	715	1.59	7.75	"
3	"	Shorthorn	303	638	1.81	6.27	"
36	Heifer	Angus	322	619	1.61	6.70	"
44	"	Shorthorn	300	540	1.30	8.75	"
61	"	"	362	746	2.08	6.19	"
2	"	Angus	283	542	1.40	8.66	"
AVERAGE			332.6	658.6	1.76	7.47	
1	Steer	Angus	352	647	1.59	7.60	Ground plus Terramycin
16	Steer	"	363	803	2.38	5.91	"
27	"	"	415	740	1.76	7.99	"
37	"	Shorthorn	391	737	1.87	7.18	"
59	Bull	Angus	430	735	1.65	7.53	"
12	Heifer	"	286	601	1.70	5.33	"
11	"	"	288	549	1.41	8.54	"
33	"	"	348	660	1.69	7.85	"
41	"	Shorthorn	350	650	1.62	8.17	"
48	"	"	300	620	1.73	6.86	"
AVERAGE			352.3	674.2	1.74	7.30	
18	Steer	Shorthorn	328	690	1.96	5.80	Pelleted, No Terramycin
34	"	"	360	618	1.39	6.47	"
58	Bull	Angus	390	750	1.95	4.69	"
62	Steer	"	365	660	1.59	5.92	"
67	Bull	"	400	Still on test			
31	Heifer	Shorthorn	325	640	1.70	6.10	"
32	"	"	295	568	1.48	4.89	"
35	"	Angus	280	545	1.43	3.92	"
54	"	"	352	645	1.58	5.61	"
AVERAGE			336.9	639.5	1.31	5.42	
19	Steer	Angus	324	540	1.17	7.04	Pelleted plus terramycin
30	"	Shorthorn	395	795	2.16	5.90	"
43	"	Angus	365	660	1.59	5.56	"
53	"	"	375	725	1.89	4.51	"
60	Bull	"	345	640	1.59	5.87	"
68	"	"	356	Still on test			
13	Heifer	Shorthorn	305	599	1.59	4.86	"
49		Angus	363	700	1.82	4.63	"
52	"	"	340	540	1.08	7.48	"
AVERAGE			351.5	650.0	1.61	5.73	

The results have not been submitted to statistical analysis. The animals on pelleted feed appeared to utilize the feed more efficiently requiring 5.42 and 5.73 pounds to put on 1 pound of gain, as compared to those on ground feed requiring 7.47 and 7.30 pounds of feed per pound of gain. There were more digestive disturbances among animals on ground feed than among those on pelleted feed.

(3) Production Testing With Cooperators.

Data on birth weights, weaning weights, yearling weights was summarized involving 235 animals from 8 cooperators. The average birth weight for 119 calves of both sexes was 62.2 pounds. The average weaning weight for 235 calves was 511.7 pounds with an average weaning age of 233.9 days. The average yearling age, yearling weight and daily gain from weaning to yearling age were 386.6 days, 735.8 pounds and 1.55 pounds per day, respectively, for 196 calves.

(4) County Bull Testing Programs.

Four counties made use of their fair-grounds to individually feed 118 calves for a period of 150 days. At the end of the feeding trial the animals were graded for type and their gains and feed efficiency were calculated. Index was calculated for each animal on the basis of the formula:

$$I = 70 + \frac{(r-\bar{r})}{(s_r)} + 5\,\frac{(e-\bar{e})}{(s_e)} + 10\,\frac{(t-\bar{t})}{(s_t)}$$

The index for each animal was obtained by using the standard deviations and the means for the characteristics calculated from data of 77 bulls previously on test. The standard deviations for rate of gain, feed efficiency and type were 0.30 lb., 74.1 lbs., and 2.5 lbs., respectively, while the means were 2.12 lbs., 647.5 lbs., and 15.8 lbs. For type score, the following arbitrary values were used:

$1^- = 23$; $2^+ = 20$; $2 = 17$; $2^- = 14$; $3^+ = 11$.

Table 3 gives the summary of the weights, feed consumption, and type score.

TABLE 3
Averages -- Total Gain, Total Feed Eaten, Initial Age, Initial Weight, Type Score, and Index on Calves by Breed and Location

Breed	Number of Animals	Total Gain (lb)	Total Feed Eaten (lb)	Initial Age (days)	Initial Weight (lb)	Type Score	Index
			COLFAX				
Angus	17	354.9	2406.9	220.2	510.8	68.0	75.6
Hereford	10	371.6	2413.5	227.6	549.5	70.4	78.5
Shorthorn	10	328.3	2254.5	221.9	508.0	57.2	61.2
TOTAL	37	345.3	2322.6	222.6	520.5	65.7	72.5
			CHEHALIS				
Angus	10	353.0	2698.1	241.8	564.5	70.4	71.5
Hereford	27	359.1	2572.0	242.8	537.8	65.8	70.3
Shorthorn	9	410.3	2822.2	217.6	438.0	64.0	76.2
TOTAL	46	367.8	2648.4	237.6	524.1	66.4	71.7

TABLE 3 (Continued)

Breed	Number of Animals	Total Gain (lb)	Total Feed Eaten (lb)	Initial Age(days)	Initial Weight(lb)	Type Score	Index
			KENNEWICK				
Angus	2	273.0	1932.5	222.0	553.5	62.0	58.8
Hereford	11	363.4	2298.6	237.1	478.9*	62.5	75.0
TOTAL	13	349.5	2242.3	234.8	490.4	62.5	72.5
			WATERVILLE				
Angus	3	268.0	1979.0	215.7	508.3	72.0	64.5
Hereford	10	315.2	2166.9	214.5	505.9	68.0	69.8
Steers	8	280.1	2194.4	225.0	488.9	----	----
TOTAL	21(13)	295.1	2150.5	218.7	499.8	68.9	68.5

(5) I^{131} Tracer Doses and Thyroid Activity as A Measure of Efficiency of Feed Utilization of Beef Cattle. (In cooperation with Atomic Energy Commission, Richland, Washington).

Tracer doses of I^{131} (100_{Mc} per animal per treatment) were administered to the 1953 calves from WSC herds on June 2, September 2, December 15, and March 8(50_{Mc}). The rate of uptake of the iodine by thyroid was measured by monitoring each animal at four-hour intervals for I^{131}. The first two periods were required to perfect the technique in monitoring the animals. In the last two periods a three-probed scintillation counter was used for measuring the concentration of I^{131} in the thyroid. This instrument has proven satisfactory.

The results of December 15 study are summarized in Table 4. The results of March 8 study will be available in the near future.

TABLE 4
Results showing maximum content of I^{131} in Thyroid gland by treatments

Calf Number	Sex	Age (days)	Max I^{131} (Mc)	Feed Efficiency (lb)	Aver.Daily Gain (lb)	Treatment
15	Male	294	14.0	3.27	1.55	Whole Milk - no
18	"	292	9.7	3.63	1.36	Terramycin
21	"	287	10.2	2.96	1.86**	"
40	"	274	11.4	3.29	1.50	"
62	"	232	13.4	3.48	1.68	"
64	"	226	14.1	3.30	1.72	"
AVERAGE		267.5	12.1	3.32	1.61	
28	Female	282	10.1	3.94	1.51	Whole Milk - no
31	"	278	15.1	4.22	1.36	Terramycin
36	"	275	9.5	3.29	1.47	"
44	"	271	11.8	4.23	1.34	"
54	"	252	12.3	3.55	1.64	"
AVERAGE		271.6	11.8	3.85	1.46	

* Second figure indistinct.
** Third figure indistinct.

TABLE 4 (Continued)

Calf Number	Sex	Age (days)	Max I^{131} (Mc)	Feed Efficiency (lb)	Aver. Daily Gain (lb)	Treatment
16	Male	293	8.8	3.26	1.57	Whole Milk - plus
22	"	286	12.3	3.31	1.44	Terramycin
27	"	282	6.8	3.19	1.88	"
30	"	279	12.7	3.27	1.81	"
37	"	275	10.7	3.41	1.71	"
53	"	253	11.4	3.42	1.75	"
60	"	240	13.2	3.71	1.64	"
68	"	197	13.3	3.82	1.64	"
AVERAGE		263.1	11.2	3.42	1.68	
11	Female	300	10.9	3.48	1.31	"
13	"	297	11.8	4.48	1.29	"
41	"	273	9.7	4.11	1.50	"
49	"	266	12.3	3.30	1.71	"
52	"	257	11.9	3.64	1.61	"
AVERAGE		278.6	11.3	3.80	1.48	
14	Male	296	10.0	3.31	1.56	Synthetic Milk - No
26	"	284	11.1	3.20	1.79	Terramycin
34	"	278	14.9	3.19	1.67	"
50	"	261	12.1	3.49	1.98	"
58	"	242	10.5	3.45	1.87	"
67	"	198	11.9	3.95	1.89	"
AVERAGE		260.0	11.8	3.43	1.79	
32	Female	278	10.0	3.89	1.32	"
35	"	276	9.9	3.47	1.24	"
61	"	238	12.2	3.80	1.55	"
66	"	222	12.5	3.71	1.46	"
AVERAGE		253.5	10.9	3.72	1.39	
19	Male	290	11.8	3.54	1.49	Synthetic Milk -
43	"	272	11.7	3.41	1.69	plus Terramycin
59	"	241	13.5	3.54	1.98	
65	"	226	11.6	3.42	1.81	
AVERAGE		257	12.2	3.48	1.74	
12	Female	298	9.0	3.64	1.28	"
33	"	278	9.6	3.43	1.54	"
48	"	267	10.6	3.98	1.27	"
AVERAGE		281.0	9.7	3.68	1.36	

(6) Body Measurements of Young Beef Calf.

Sixty-two calves from WSC l[illegible]d were used in this study to obtain measurements of different parts of the body. Eight measurements were taken: (1) height at withers, (2) length of body, (3) heart girth, (4) width of rump, (5) length of head, (6) width of head, (7) width of muzzle, and (8) body weight. These were taken in May, June, July and August at 28-day intervals.

This data is being summarized and analyzed.

V. Work Plan for the Future:

1. Production Testing -- WSC Beef Cattle

(1) 1953 Calves -- (raised without their dams)
Study of growth continued until maturity
a. Weight - monthly
b. Body measurements - heart girth, height at withers, length, width between hips, head measurements

(2) 1954 Calves
A. Study of growth
a. Birth weights
b. Weight every 14 days
c. Body measurements
B. Feed Efficiency Studies -- Weaning to one year of age.
a. Weights - weaning, interval weights, final.
b. Feed consumption - individual
C. Protein Bound Iodine Studies
a. Blood samples - monthly
b. Correlation studies PBI - gains, feed consumption
D. I^{131} Studies - At weaning and at one year of age.
E. Fattening Steers
a. Comparison of fattening rations
b. Blood samples - antipyrene method
F. Age of Puberty in heifers
To determine the age of puberty in females - use of vasectomized bull and rectal palpation.

2. Production Testing with Cooperators

Objective:

To cooperate with the breeders throughout the state of Washington for the improvement of beef cattle.

Animals:

All calves in the herds of cooperators will be individually identified and used for collection of data.

Feeding:

Animals will be group fed a good growing ration (Breeders choice) Record of constituents of ration and total amount consumed will be kept.

Data to be Collected:
a. Pedigree
b. Weights -- weaning and yearling
c. Grade - yearling
d. Rate of gain (weaning to the year of age)
e. Record of total feed consumption

3. Production Testing of Bulls by Counties

Repeat work plan 1953-54.

4. Production Testing Bulls on Individual Ranches

Objective:

To encourage breeders to set up bull testing program on individual ranches by following the plan of the county testing program.

VI. Publications and Manuscripts:

Ensminger, M. E., M. W. Galgan, and L. K. Bustad. I^{131} Tracer Doses and Thyroid Activity as a Measure of Efficiency of Feed Utilization in Beef Cattle. (Manuscript Prepared).

Foster, D. E., M. W. Galgan, and M. E. Ensminger. 1953. Pelleted vs. Non-Pelleted Rations for Beef Cattle. Wash. Agr. Expt. Sta. Cir. 232.

Galgan, M. W., M. E. Ensminger, E. M. Hanks, and F. K. Bracken. 1953. Raising Calves From Birth on Synthetic and Reconstituted Milk. Wash. Agr. Expt. Sta. Cir. 234.

Galgan, M. W., M. E. Ensminger, and C. R. Kyd. Production Testing Beef Cattle in the State of Washington. (Manuscript Prepared).

Ham, W. E., M. W. Galgan, and M. E. Ensminger. Blood Levels of Protein Bound Iodine as an Indicator of Potential Rate of Gain in Beef Calves. (Manuscript prepared).

I. Cattle Inventory
A. Purebreds

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

State Washington
Date June 15, 1954

Line designation	1	2	3	4
Breed	Angus	Hereford	Shorthorn	Hereford
Station	Main	Main	Main	Prosser
Bulls (12 mo. or over)	8	4	2	3
Cows (2 yrs. or over)	32	20	19	12
Heifers, yearlings	7	--	4	6
Male calves	12	7	9	5
Heifer calves	17	--	7	2
Percentage use for breeding project	65%	65%	65%	100%
Estimated cash value	$36,550	$15,500	$15,400	$11,200

II. Young Animals Which Were on Feed During 1953-54.

A. Purebreds

	Herefords			Angus			Shorthorns		
	No. Individually Fed		No. Group Fed	No. Individually Fed		No. Group Fed	No. Individually Fed		No. Group Fed
	Birth to 180 days	180 days to 1 year		Birth to 180 days	180 days to 1 year		Birth to 180 days	180 days to 1 year	
Bulls	7	3	--	21	9	--	6	1	--
Heifers	5	5	--	14	10	--	9	7	--
Steers	--	--	--		10	--	--	4	--

III. Additions of land physical facilities and equipment during fiscal year 1953-54.

Item	No.	Actual Cash Value	Percentage use for beef breeding project	Remarks
Portable Scale	1	$ 150.00	100%	
Self Feeders	50	500.00	100%	
Grading Area Wintering Quarter		965.78	100%	
2-Ton Truck	1	2,800.00	66%	

IV. Funds expended during fiscal year 1953-54 (estimated for remainder of year).

Source	Amount Non-recurring items	Amount Operating Expense
9 b3 Fund 44	--	$5,000.00
Fund 45	--	3,969.91
BAI funds	--	--
State-controlled funds	$1,615.78	$21,311.81

Wyoming

I. Station: Agricultural Experiment Station, Laramie, Wyoming.

II. Title of Project: Improvement of Beef Cattle Through the Application of Breeding Methods.

III. Personnel: Paul O. Stratton, N. W. Hilston, and C. P. Stroble. (Also permanent and temporary farm laborers and graduate students)

IV. Nature and Extent of Work Done This Year: (University Farm, Laramie)

1. Bred cows to further the development of the lines of Hereford, Angus and Shorthorn.

2. Scored, measured (heart girth, height at withers, depth chest, width shoulders), profiled, and photographed, using a 6" grid behind which the animal stands, all project animals at weaning last fall. All progeny were scored, measured, profiled and photographed again at the end of an 168-day feed test.

3. All progeny (male and female) in all lines were individually fed for an 168-day period. Bull calves were individually fed a ration of two parts concentrate to one part alfalfa hay. Heifer calves were individually fed a ration of one part concentrate to one part alfalfa hay.

4. Observations on the bull progeny were made on two time a day feedings at individual feed bunks as compared to overnight feedings. At the completion of two weigh periods, all bulls were placed on two time a day feeding, since slightly better gains and less bloat were noticeable in these lots.

5. All progeny were bled and blood typed at the close of the feed trial.

6. Selections for replacement breeding stock were made on the basis of record of performance.

7. All progeny not retained for breeding stock were slaughtered and carcass evaluation obtained following recommended procedure for measuring and grading by Reciprocal Meat Conference, 1952.

8. Initiated a comparison study of metabolic rate as measured by body temperature on normal calves, calves from known carrier cows, and dwarf calves.

9. Profiles on approximately 175 young horned Hereford bulls, in cooperation with Wyoming ranchers, were obtained at approximately 12 months of age and again at 17 months. On a few of these bulls a third profile was taken at 24 months.

10. Cooperated with the extension personnel in profiling mature horned Hereford bulls as a service to breeders. The profiles are taken by the extension men and turned over to this laboratory to be keyed out and returned to the cooperating rancher.

11. Profiled and bled at Pan Tech Station, Panhandle, Texas, and at the U. S. Range Livestock Experiment Station, Miles City, Montana.

12. Work was continued to examine the effects of the dwarf factor on head form of heterozygous Hereford cows and to develop a method of identification.

13. Combining ability tests of Miles City Line 1 sires on an outbred and inbred population of Hereford females were continued.

Gillette Station:

1. Bred cows to further the development of the Hereford line to perpetuate an inbred line of cattle already established in the state.

2. Scored, measured, and profiled all project animals. All 1953 progeny were scored, measured and profiled again at the end of an 168-day feed test. All bull calves were fed individually; heifer calves group fed.

3. Selection for replacement breeding stock was made on the basis of ROP. Carcass data were obtained on all progeny not retained for replacement.

V. Summary of Progress and Conclusions to Date:

(a) The data accumulated on head form of heterozygous and assumed clean cows were not productive. No clear cut evidence was found that gave indication of any rise, bulge or other frontal bone irregularity being associated with only heterozygous cows. Limited data accumulated on heifers gave a slight indication that results could be expected to be more favorable, prior to any pregnancies. It would appear that if fetal hormone stimulation is possible, one or more pregnancies might correct, partially or entirely, any disproportionate head growth caused by the dwarf factor, thus confounding our cow data.

Table I is a preliminary report on temperature study initiated this year.

Table I.

Calf No. Breed & Sex	Calf Genotype	Dam Genotype	Sire Genotype	Age on Test	Test Period	Mean Temperature
54 H ♂	Unknown	Unknown	DD	3 days	42 days	103.41
84 H ♂	Unknown	Unknown	DD	2 days	42 days	102.68
94 H ♀	Unknown	Unknown	DD	1 day	42 days	102.59
124 H ♀	Unknown	Unknown	DD	1 day	39 days	102.56
134 H ♂	Unknown	Dd	DD	1 day	38 days	102.48
144 H ♂	Unknown	Dd	DD	1 day	37 days	102.63
184 H ♂	Unknown	Unknown	DD	1 day	30 days	102.90
1 H ♂	dd	Dd	Dd	52 days	4 days	101.70
2 H ♀	dd	Dd	Dd	45 days	4 days	102.10
3 H ♀	dd	Dd	Dd	15 days	4 days	103.33
4 H ♂	dd	Dd	Dd	10 days	4 days	101.68
5 H ♀	dd	Dd	Dd	14 days	30 days	102.24
H ♀	dd	Dd	Dd	2 yr.	31 days	101.01
S ♀	dd	Dd	Dd	1 yr.	31 days	101.71
Sh St.	dd	Dd	Dd	1 1/2 yr.	31 days	101.46

The 1954 calf crop are the first calves produced from the matings of an inbred sire to the outbred Hereford cow herd, and to Hereford females from a commercial inbred herd. The birth weights on the 1954 calves are greater than the birth weights of calves from the same outbred cows, years previous, by an outbred sire. This year's calves from the inbred X inbred matings were heavier at birth than this year's calves from the inbred X outbred matings.

IV. and V(b) - Progress on blood typing:

(b) Since its establishment, the University of Wyoming Blood Laboratory has blood typed 1613 head of cattle. These animals were typed with four main objectives in mind. Fifty-six head of the University dairy herd were typed to add to those typed by the California Laboratory in providing a source of immune sera. There were 614 head of beef cattle from 8 states typed to furnish data used in a study of the possibility of an association between blood groups and feed lot performance. This study was used as material for a doctorial thesis. Since that study, 177 head have been typed to increase the numbers for a more thorough study of the possibility that blood groups may be indicative of economic characters. There were 617 head from 9 lines of Miles City cattle blood typed to provide data for an immunogenetic study of that herd. This material was used in a Master of Science Thesis, and will be reported at the Western Section Meeting in Corvallis. There were 175 head of cattle typed to provide data for a study of the possible association of blood groups and the genotype at the dwarf loci as determined by profile. As yet, no statistical analysis has been made on this study since the volume of data is not felt to be sufficient.

Incident to these studies and as a service to W-1 cooperators, 3 parentage problems have been attempted. These are: Gietz herd (on request by the Wyoming and California Stations, and the regional coordinator), result: exclusion of the suspected sire; University of Arizona, no exclusion; Colorado A. & M. - no exclusion.

A breakdown, by state, of animals blood typed follows:

Wyoming:	132	- including dairy animals and animals from the Gietz herd.
Montana:	813	- including herd sires in all 9 lines, breeding cows in all lines and 2 years of feed trial bulls from Miles City, as well as bulls from Bozeman and Havre.
Texas:	254	- two years of feed trial bulls at Pan Tech.
Nebraska:	157	- one year of feed trial bulls at Crawford.
Idaho:	72	- from Idaho State and Caldwell.
Washington:	11	- feed trial individuals.
Utah:	17	- feed trial individuals.
Colorado:	75	- feed trial individuals.
Oregon:	76	- feed trial individuals.
Arizona:	3	- Parentage study.
New Mexico	3	- Individual identification only.

VI. Work Planned for the Future: (University Farm and Gillette Station)

1. The continuation of present program with regard to score, measurements, profiling and photographing of all progeny at both stations.

2. Individually feed all calves for an 168-day test period following weaning.

3. Obtain carcass data on those calves not selected to be retained in the breeding herds.

4. Cooperate with State breeders in profiling and in keeping records to help in selection and in their feed-testing programs.

5. Analyze data and determine heritability on body measurements; analyze feed test and carcass data for possible associations.

6. Analyze data on combining ability tests of inbred X outbred and inbred X inbred populations in Herefords.

7. Continue our study for practical methods of identifying heterozygous females for the dwarf factor.

8. Analyze data now available on young horned Hereford bulls in an attempt to develop means of distinguishing between carrier and clean bulls at a younger age.

9. Continue the initiated body temperature studies of normal and dwarf calves.

10. Continue the present work on blood typing. Make a more thorough study of the possible association of blood groups and economic characters. A further immunogenetic study of the Miles City inbred lines will continue.

11. Initiate a study of blood constituents as a possible indicator of economic characters.

VII. Publications Issued or Manuscripts Prepared During the Year:

Gregory, P. W., C. B. Roubicek, F. D. Carroll, P. O. Stratton, and N. W. Hilston. December 1953. Inheritance of Bovine Dwarfism and the Detection of Heterozygotes. Hilgardia, Vol. 22, No. 13.

Mason, Robert W. An Immunogenetic Study of the Miles City Inbred Lines of Beef Cattle. M.S. Thesis (in preparation).

Schoonover, Carroll. January 1954. A Dye Brand for Identification of Beef Cattle. Wyoming Agr. Expt. Sta. Cir. No. 38.

Schoonover, Carroll. 1954. A Study of Recessive Dwarfism in Hereford Females. M.S. Thesis.

Stratton, P. O., and Tony Fellhauer. Summer 1953. What About Dwarfism. Wyoming Roundup.

Stratton, P. O. October 1953. Progress on Dwarfism. Cow Country.

Stratton, P. O., and Tony Fellhauer. December 1953. Tests for Dwarfism in Beef Cattle. Wyo. Agr. Ext. Mimeo. Cir. No. 1.

Stroble, C. P. 1953. A Study of the Possible Association of Blood Groups and Feeding Characteristics in Beef Cattle. Ph.D. Thesis.

Stroble, C. P., P. O. Stratton, and R. O. Gilden. October 1953. Portable Cattle Scale. Wyo. Agr. Expt. Sta. Cir. No. 52.

I. Cattle Inventory
A. Purebreds

BEEF BREEDING PROJECT SUMMARY
Fiscal Year 1953-54

State Wyoming
Date June 30, 1954

Line designation					
Breed	Hereford	Shorthorn	Angus	Hereford	Hereford (B. Grade)
Station	Laramie	Laramie	Laramie	Gillette	Laramie (Dryer)
Bulls (12 mo. or over)	3	3	2	4	
Cows (2 yrs. or over)	30	32	23	28	10
Heifers, yearlings	6	3	4	8	2
Male calves	11	14	11	6	3
Heifer calves	14	10	4	15	2
Percentage use for breeding project	100%	100%	100%	100%	100%
Estimated cash value	$11,250	$11,925	$8,100	$8,850	$2,195

II. Young animals which were on feed during 1953-54

	Herefords				Angus				Shorthorns			
	Number Individually Fed		Number Group Fed		Number Individually Fed		Number Group Fed		Number Individually Fed		Number Group Fed	
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Bulls	19	2			2				5			
Heifers	9	2	10		4				3			
Steers		12										

A. = Purebreds
B. = Grades

III. Additions of land, physical facilities and equipment during fiscal year 1953-54.

Item	No.	Actual Cash Value	Percentage use for beef breeding project	Remarks
Shorthorn Bull	1	$1,325.00	100%	
Angus Bull	1	400.00	100	
Feed Bunks	2	480.00	100	
Corrals	3	300.00	100	
Scale rebuilding	1	75.00	100	
Fencing		1,232.00	80	
Feed trailer	1	165.00	80	
Bridge	2	320.00	50	
IBM card file	1	189.00	100	
Tractors (lease)	3	960.00	50	
Neck Chains		35.00	100	
Drill Press	1	175.00	40	
Skill Saw	1	140.00	20	
Bale Loader	1	325.00	70	
Hay Maker	1	1,600.00	70	
Camera	1	465.00	80	
Needle Sharpener	1	30.00	100	
Typewriter	1	375.00	30	

IV. Funds expended during fiscal year 1953-54.

Source	Amount non-recurring items	Amount Operating Expense
9 b3		$ 6,700.00
BAI Funds		2,550.00
State-controlled funds	$ 6,051.00	24,298.00

Discussion following Arizona report:

Dr. Gregory referred to the profilometer test in the Arizona report and pointed out the difficulty of properly classifying calves under field conditions that are premature or stillborn. He also suggested the possibility of more than one kind of genetic dwarfism in Hereford cattle.

Discussion following Hawaii report:

Dr. Wayman pointed out that even under conditions of a severe drought they were able to demonstrate sire differences in progeny performance. Many of these same sires are being used again and since environmental conditions are much improved, it will provide an opportunity to see if similar sire differences are again evident. It will provide an excellent opportunity to measure sire-year interaction under near extreme conditions.

Discussion following Idaho report:

Dr. Sierk stated that the experimental herd at Idaho is now completely converted to spring calving. Since cooperative bull testing at Caldwell has now been discontinued, the Idaho project is being revised. Feeding procedures and nutritional aspects of performance work will be emphasized.

Discussion following Montana report:

Professor Willson explained that data on daily gain shown in the Montana report were unadjusted. The station is now using 2 bulls per line on the test herd, 15 cows per bull. These bulls are selected for testing on the basis of individual performance. Data are now being analyzed to compare feed-lot and grass performance. Preliminary estimates show genetic correlations between .3 and .6.

Discussion following Nevada report:

Dr. Kidwell indicated that antipyrine studies to date appear very promising. The Nevada station is now starting cooperative bull indexing for ranchers. He reported that industry in Nevada is now recognizing the possibilities of improving range cattle through the application of changed breeding methods. Dr. Kidwell also briefly discussed the objectives of the revised Nevada project. Dr. Stonaker pointed out that the effect of selecting for the same factors under high and low nutritional conditions is worthy of considerable study. He stressed the importance of having the initial design of the project set up on as sound a basis as possible. It was decided that the group would discuss the project design in more detail later.

Discussion following New Mexico report:

Dr. Blackwell stated that he was preparing the New Mexico data for IBM analysis and hoped to proceed with the analysis this fall. Dr. Blackwell described differences that he has noted in the closure of the orbital foramen between dwarf skulls and suggested that this might be indicative of different dwarf types.

Discussion following U. S. Range Livestock Experiment Station report:

Dr. Madsen asked about the profile and dwarf status of the station herd. Dr. Woodward replied that a long-headed dwarf from line 5 was now in the California dwarf herd. This was the only line in which dwarfism has been definitely established, although there have been a number of stillborn calves from other lines that have not been definitely classified. All mature bulls and young bulls have been profiled. Some of the line herd bulls profile as carrier and in the young bulls some carrier-type profiles have been observed in all lines except line 10.

Discussion following Utah report:

Dr. Madsen suggested that a more accurate estimate of glutamic acid excretion might be obtained if animals were fed a low protein diet. Dr. Gregory asked if glutathione had been tested. Professor Bennett indicated it had not.

Discussion following Washington report:

Dr. Galgan reported that the viability of the calves raised on synthetic milk was very good. Out of 68 calves, only one died and that was from white muscle disease. He also reported that in comparing pelleted and non-pelleted rations no differences were observed in rate of gain, but the animals fed the pelleted feed did show an advantage in pounds of feed per pound of gain. Professor Bennett described a commercial feeder near Ogden that had compared pelleted and ground mixed feed on two lots of 100 head of heifers. The animals on ground mixed feed gained faster and finished earlier. This was a high concentrate ration and the average rate of gain of the heifers was 2.7 lbs. per day. Dr. Whiting stated that at a concentrate/roughage ration of 2:1 his experimental animals appeared to be gaining more rapidly on the pelleted ration.

Discussion following Wyoming report:

Dr. Stratton discussed the work that had been done in an attempt to classify cows by head form. Establishing control cows to use as dwarf-free models is an obvious difficulty and there does appear to be a confounding effect due to pregnancy which may necessitate using only young heifers.

Report of Committee on a Proposed Workshop: Dr. Bogart and Dr. Blackwell.

The committee pointed out some of the desirable features of a regional workshop, including the mutual discussion and exchange of ideas on experimental design, data analysis, and interpretation. They pointed out that it could be a stimulant for analysis of data that are now accumulated. They presented two plans, one for a short workshop of one or two days and the other more extended workshop of a week or more in which the host institution would offer graduate credit to students attending the workshop. They suggested that the workshop be held just prior to the W-1 Technical Committee meeting at the host institution or one adjacent. An authority from outside could be brought in as a consultant with lectures and seminars as part of the workshop plan. They recommended that a committee be appointed to handle the necessary details for a workshop next summer.

Dr. Sierk moved that the committee report be accepted and a new committee be appointed to plan and implement the workshop for the coming year. Seconded by Dr. Bogart. Motion carried.

Chairman appointed Dr. Bogart, Dr. Blackwell and the technical committee member from the host institution to the new workshop committee.

Motion by Prof. Willson that, if possible, the W-1 meeting in 1955 be held in a state adjacent to the host institution of the Western Section meeting, and that the W-1 Technical Committee Meeting be held just previous to or just after the Western Section meetings. Seconded by Dr. Wayman. Motion carried.

Dr. Blackwell made the motion that if the Western Section meetings are held at Laramie in 1955, the W-1 meetings be at Ft. Collins. Seconded by Professor Pahnish. Motion carried.

Report of Record and Forms Committee: F. S. Willson, Chairman.

The committee presented for the group's consideration the IBM work sheets that have been used at the Havre station. These may serve as a model for similar work at other stations.

The chairman listed the W-1 executive committee for 1954-1955, as follows: Dr. Wayman (chairman), Dr. Loubicek, Dr. Wheeler, and Dr. Stonaker.

The chairman asked if there were any suggestions for guest speaker at the next technical committee meeting and workshop. A number of suggestions were made. Dr. Sierk moved that the choice of who is to lead the workshop be left to the workshop committee. Seconded by Dr. Kidwell. Motion carried.

Dr. Wheeler informed the group that expense accounts would be handled in the usual fashion through the Administrative Assistant at Colorado A. & M. College. Dr. Wheeler then asked for suggestions concerning the expenditure of any residue P. & C. funds. Dr. Sierk moved that the expenditure of any excess funds left in the trust fund after the expenses of the W-1 Technical Committee have been paid be decided by the Administrative Advisor and the Regional Coordinator. If the sum is in excess of $500, the Technical Committee should be canvassed to determine how the fund should be spent. Seconded by Dr. Kidwell. Motion carried.

Dr. Wayman suggested that stations contact the Administrative Advisor by April 1 informing him of their needs which might be taken care of by a surplus in the P. & C. fund.

Project revisions for Oregon, Nevada and California were approved by the Committee.

The design of the revised Nevada project was discussed. Dr. Kidwell thought that the grade cattle in the station herd could be sold and the receipts plus other funds used to purchase registered cattle. Dr. Bogart moved that the W-1 Committee recommend to the Nevada Experiment Station that if at all possible the grade herd be sold and the money obtained from the sale be used for the purchase of suitable registered cattle. This would permit more effective design of the Nevada project since it would permit complete randomization of the entire herd. Seconded by Professor Willson. Motion carried.

Dr. O. E. Reed, Director, Livestock Research, Agricultural Research Service, U. S. Department of Agriculture, described the Agricultural Research Service pattern under the new Departmental reorganization. He also indicated that he was hopeful of a decided increase in funds available for research in the future.

Dr. Wheeler, Administrative Advisor for W-1, addressed the group. He pointed out that his duties as Administrative Advisor appeared to be rather well spelled out; still, there were additional duties which are there by implication. He felt that one of his chief responsibilities was to request and defend an adequate budget for the project. He asked the group to work with him in providing suitable information so that he could properly answer questions put to him by the other Directors when the project is discussed. He asked especially for clear and concise statements of progress and results from each contributing project. He stressed the importance of teamwork in order to have maximum effectiveness in this work. In order to make a fair and equitable distribution of 9b3 funds allotted to the project it is necessary to have the thoughts and advice of the Technical Committee, and National and Regional Coordinators.

Mr. J. O. Grandstaff, Office of Experiment Stations, suggested that it might be time to consider a Regional Project revision. He also asked that in revisions of State contributing projects a title be assigned that is actually descriptive of the work being undertaken at the station. He pointed out that W-1 was through the development phase and was now in a contributing phase. This means that every State contributing project should be as strong as possible.

W-1 Regional Coordinator Report

Any report concerning the year's activity must include dwarfism research as one of the more important activities. There are some who state that this part of the work has been over-emphasized and that it should be relegated to a minor status with only one or two stations devoting a portion of their effort to the study. I have felt that the work deserved a rather high priority. First of all, industry is demanding help and our whole program is for the single purpose of helping our beef cattle industry. Secondly, dwarfism is present in a large portion of our experimental herds. It will be virtually impossible to use these herds for genetic improvement. It is necessary that we eliminate the gene from our experimental herds so that we cannot be rightly accused of disseminating dwarfism through the animals we sell.

Dwarfism research does have a potential and actual value far greater than the results we obtain in control of the characteristic. Most of our investigations are so designed that we are getting critical information about the normal functions of our beef animals. The anatomical information relative to normal growth and accurate measures of individual maturity will be most helpful in properly evaluating normal animals. As a rather interesting example, it has been pointed out to me that profile results from young animals indicate that the profile may serve as an extremely effective means of identifying identical twins.

Some stations are studying blood and urine constituents in the hope of finding a means of identifying animals heterozygous for dwarfism. However, these analyses are not confined to this single study but include animals with performance records. There is a good probability that from this phase of the work may come some much needed information to help us classify young animals into relative performance groups. Other phases of the dwarfism research which include physiology, endocrinology and embryology, should give us important basic information for the work we must do in bloat, infertility, and other similar problems.

One of the most evident contributions of dwarfism research is directly associated with record of performance. It has provided us with a vehicle for introducing record of performance to ranches and areas which otherwise would not be available to us. We very definitely have introduced to many producers a more complete, more accurate system of records which will be very worthwhile to them in their future operations. In those states where extension has served as liaison between the research worker and the producer, it has provided the state extension service with many extra contacts and thereby an opportunity to include these producers in a record of performance program. Although the Western Region under W-1 has conducted the major share of all dwarfism research, it has constituted only 10% to 15% of our total effort. Of over 116 publications in W-1, only 5 are based on the research on dwarfism. As Coordinator, I have attempted to schedule my work so that about 25% of my time is spent on dwarfism research. The fact that the results of the dwarfism research have been so large in relation to the limited effort is due to the outstanding cooperation of the station workers in this region, including the complete and free exchange of material and ideas.

In the Western Region, record of performance in some form includes virtually all the rest of our research effort. The analysis of accumulated data is proceeding exceptionally well, and the new IBM facilities available in Denver will be invaluable to those stations that have sufficient data to make adequate use of this equipment. Our data and records are now more extensive and more refined than those that served in earlier analysis, but the results to date substantiate the earlier conclusions relative to the importance of record of performance work. We are in need of more expeditious methods for accurately classifying animals as to performance. Many possibilities are being explored, including the tie-in with dwarfism research which was previously mentioned. Perhaps the greatest need in record of performance work is an organized information program which would provide industry with a sound and serviceable basis for adopting record of performance procedures. The value of such a program for research, extension and industry is unlimited, but as yet it has not received the necessary support to get underway.

Our contacts with industry have consistently shown that they support the research program and are depending on it to help them. It has been rather disconcerting to find that long established research results are not available to the producer. These people blame the research worker, stating the the experimental

results are confounded by technical language and buried in scientific journals not even available to the great majority of the people that could use the information. I am sure that many of us have assumed that the farm press and extension service was keeping the producer at least fairly well informed as to what the research worker was doing. Apparently this is not the case. It may be necessary for the research worker to take time from his regular duties and spend even more time on "missionary" work.

We have collaborated with the ANCA in preparing a questionnaire which is to be included as a tear sheet in their publication. Since any such enterprise is at best a compromise, this questionnaire will be primarily concerned with fertility and some of the more prevalent health problems.

We anticipate a response to this questionnaire which will enable all of us to more accurately evaluate some of the pertinent problems facing the producer. It could serve as an extremely useful guide in setting up new projects and for informing us of the already established experimental findings which have not been passed on to those that need them. If this effort is successful we hope to broaden the information by subsequent questionnaires.

Remarks of Dr. R. T. Clark, National Coordinator

I have been asked to review the cooperative research work in beef cattle breeding. Dr. Madsen has agreed that, in part, I should use for this purpose the material that I presented at a Washington, D. C. conference on April 12-15, 1954.

For the sake of brevity, since it is getting late and you have listened to a lot of talk, I will speak informally now on a few topics, and the gist of the material will be presented as an attachment to the minutes of this meeting.

(Dr. Clark then delivered a short historical summary of how the first regional project, W-1, was developed and the manner in which he and others associated with him got the project organized. He then referred to the procedure and policies which he and his associates later followed in the primary organization of NC-1 and S-10).

I have observed that a few people are concerned about disagreements among the members of the Technical Committee. I am reminded of an occasion when Dr. H. K. Hayes, of the University of Minnesota, addressed the collaborators in Bill Craft's Regional Swine Laboratory. It was the first swine breeding meeting Hayes had attended. He contrasted this meeting with the many plant breeders' conferences he had attended. He felt that the swine meeting was entirely too placid and too devoid of arguments, differing therein from plant breeders' meetings where they expected disagreements and good healthy arguments and were disappointed if they were not hot and heavy.

In my own opinion we have nothing to worry about in W-1 provided the people who may choose to disagree on certain methodology or concepts express their differences in an open and ethical manner. After a number of years of working in this business of coordination with people in many stations and various walks of life, I am convinced that without differences in viewpoint in this national program we would have a stagnant, non-dynamic program showing evidence of sheer inertia. Therefore, to the people who are spending time worrying about differences of opinion I would recommend they devote that time to preserving the free and unfettered opportunity for the workers in this team effort to express themselves without fear of recriminations or biased judgment. That is what prompted me to see that Gregory was provided with a sanctuary where his work could be examined critically and where he could develop maximum cooperation with private breeders, for industry was demanding a quick and practical solution to that problem.

And it was difficult for us to provide that with our extremely limited budget and facilities. It would have been easy to have avoided becoming involved in that work. Anyone who is interested in creative research does not choose the easy way if he has any gumption. In passing, I should state that I have never known two more devoted and hard-working associates than Gregory and Roubicek. Civil Service hours of duty meant nothing to them.

In that same connection, it has been pointed out to me by several interested persons that despite the measure of progress evidenced in our national program in beef cattle breeding, as borne out by the number of publications and widespread interest in our work, never once has this program or any individual connected with it received formal recognition in any citation program of the Government. I have been unable to answer some of the searching questions

addressed to me on this point, but I would be remiss if I failed to cite here at Miles City a co-worker in Superintendent J. R. Quesenberry who has devoted practically a whole lifetime to this type of work. He would be the last to expect any formal recognition, but it looks queer to some people, Louis, who are real friends of the Department, that not even a unit citation to W-1, the original regional project, has ever been made despite national and international appreciation of the contributions to knowledge that have stemmed from this program. Perhaps you can correct this situation, Louis.

The beef cattle industry is now waking up to the fact that through research a more efficient beef business can be developed. From the work that we have been able to do at Denver with organizations such as the American National Cattlemen's Association and other farm and ranching groups, you will see the dividends in the near future. This industry is now seeking far more than the current research program will permit. They are bringing to us constantly many unanswered questions. They want to help us build a more realistic program. Such an Industry-Research hook-up has been possible only by working from a field location such as Denver rather than Washington and was visualized when Dr. B. T. Simms, as Chief of our Bureau, established Denver as the focal point in our beef research program. All of the forward-looking views he expressed in 1949 have been amply borne out for he appreciated the desirability and prime necessity of industry-research cooperation at the grassroots level. In carrying out his policy, he said, "We are going to locate you in the field, for, in spite of all the promises I might give you, if you were located here in Washington, you would soon become a paper shuffler like all the rest of us and I think you can make a more important contribution than that."

In closing, I would like to express to all of you my most sincere appreciation of the cooperation that you have given me and the several regional coordinators. We have built a team effort which, I am quite confident, will continue to shine as an outstanding example of true cooperative research devoted to the interests of the largest economic segment of the livestock industry--beef cattle.

Dr. L. L. Madsen, Head, Beef Cattle Section, Agricultural Research Service, addressed the group. He indicated his pleasure in being back with the group and noted that he could observe real progress in the work. He was particularly pleased to see that the beef cattle herds at all the stations were now dedicated to research. He pointed out that one of the major reasons for cooperative research was to increase the numbers of animals in order to more quickly find answers to the research problems. There are still many problems that need cooperative research, including meats, fertility, and normal growth. Dr. Madsen cited examples of the spread of research results from this country to other countries. He suggested that workers in other basis sciences are also interested in our work and should be encouraged to participate. He used dwarfism research as an example of this kind of effort.

Dr. Madsen explained that a special allocation of $51,800 had been authorized by Congress for dwarfism research. From this fund $5,500 is charged to administrative expenses and in addition a histologist stationed at Beltsville would be paid half salary. The balance of the research money is to be divided equally among the three regions.

He also discussed a proposed personnel change in which the Western Coordinator, Dr. C. B. Roubicek, would be shifted to full time dwarfism research. He would be moved to a State station or remain in Denver depending upon the type of project undertaken. Dr. R. T. Clark, the National Coordinator, is given the choice of moving to Washington to serve as consultant to Dr. Madsen, or remaining in Denver as Western Regional Coordinator.

The following resolutions were unanimously passed by the W-1 Technical Committee:

I. Resolve, that a vote of appreciation be extended to Dr. Clair Terrill and Professor Knox for their informative addresses on most timely problems.

II. Resolve, that the U, S. Range Livestock Experiment Station, Miles City, Montana, be commended for the excellent hospitality and extensive tour of the station provided for the 1954 meeting of the W-1 Technical Committee.

III. Resolve, that at the next W-1 Technical Committee meeting, committee members be encouraged to bring the following data on progeny of all project animals:

PROGENY TEST WORK SHEET

Cow Number	Age of Cow	Sire of Cow	Calf Number	Sire of Calf	Remarks

SIRE PROFILE DATA

Animal Number _____

Breed _____

Age _____

Head Length _____

Head Width _____

M 1 X 1 _____ X 2 _____

M 2 X 1 _____ X 2 _____

Offcenter X'1 _____ X'2 _____

Remarks:

PROGENY DATA: From Sire Number _____

(Indicate number of progeny for each category)

Classification of Dam	NUMBER OF PROGENY			
	normal	dwarf	premature or stillborn	died before two months of age
Proven carrier				
Daughters of proven carrier bull				
Daughters of proven clean bull				

(Indicate number of progeny for each category)

Classification of Dam	NUMBER OF PROGENY			
	normal	dwarf	premature or stillborn	died before two months of age
Daughters of bull profiled carrier				
Daughters of bull profiled clean				
Daughters of bulls classification not known				

Number of cows bred to this bull that did not calve _____.

Remarks:

IV. Resolved, that in view of the importance of taking current research information to the beef cattle industry, the W-1 Technical Committee urges that Extension Animal Husbandman from each station be invited to attend the Annual Meetings of the W-1 Technical Committee to exchange information and ideas, and that the Chairman of the 1954-1955 W-1 Technical Committee distribute these invitations to all Station Extension Directors.

V. Whereas, the Technical Committee members feel that beef cattle breeding research has been aided materially in the past through the efforts of the National and Regional Coordinator and that the need for coordination of the work at various stations will be even greater in the future than it has been in the past, it is resolved that the W-1 Technical Committee recommend extending the position of Western Coordinator and National Coordinator with their headquarters to remain in Denver with their existing personnel.

Beef Cattle Breeding Research for the Immediate Future

By J. H. Knox
New Mexico State College
State College, New Mexico

When he assigned me this topic your chairman asked that I tell something of my philosophy and experience. Like most college professors, I am long on philosophy and short on experience. My philosophy on this subject can be stated in a few words.

The purpose of breeding research is to give cattle breeders the facts and guidance they need to develop sound breeding programs. Many believe, probably with justification, that the breeding of beef cattle is guided more by fancy than by sound principles. Some accuse breeders of being at fault. In my opinion, if beef cattle breeding is being conducted on the principles of 40 years ago, we may look for the trouble much nearer home. Men who adopt the latest and most progressive methods in all other phases of their operations do not follow unsound breeding practices from choice. I am reminded of a conversation with a retired army officer in our community during the last war. He told me that men of all nations make good soldiers if they were well equipped, well trained, and given the proper leadership. The same principle holds here.

If each state project is planned to meet the needs of its state, the proper balance among projects in the region and among the various regional projects is most likely to be achieved. Such a plan usually will suit the facilities available and receive the support of stockmen. It is interesting to note that the projects in the North Central region tend strongly to the establishment of numerous lines while those in the Western region are more in the direction of testing efficiency of feed utilization. I don't know that there is anything wrong in this but it seems hardly in line with the above suggestion. We can profit by studying other plans but no project is good enough to copy. The goal should be to supplement, not duplicate. Each project leader should be alert to help with emergency problems of national or regional scope. The dwarf problem is a good (or if you chose--bad) example. The major part of the work can be done most effectively by a few stations but the facilities of all stations should be available to help with certain phases. Personnel should be observant in an effort to make contributions to the final solution.

With this hastily sketched background it remains only to point out some of the fields in which I think our work may be most effective in the near future. Time, as well as limited vision, will make my comments incomplete. I expect all of you will disagree with some things I say and I am sure all of you will have good ideas that I fail to mention. I might start by saying the controversy over little cattle seems to be pretty well settled. This station at Miles City has been an important agent in bringing this about. I think this is a major achievement for certainly nothing very constructive could be done as long as the idea prevailed that cattle had to be little in order to be good. Now things have started in the other direction, I think we can expect the change to continue. One of our jobs may be to show that size alone doesn't make efficient cattle.

I think one of our major responsibilities is to devise and test methods of selection and plans of breeding for the man on the ranch. This is of primary importance in my opinion because: 1st of all, selection is most effective when conducted

under the conditions under which the cattle are to be produced and, secondly, this is the only way that anything very worthwhile is going to be accomplished. Methods to be of value must be usable by the man who breeds the cattle. I have watched with much interest the work being done with hogs at Washington. Arizona, as well as others, has been w orking hard on this problem. I am interested in Nevada's new project. I think much good could come from it. Related to this matter of selection is the question of visual appraisal or grades. It has been noted that our present system of grading feeder cattle is often negatively correlated with gains and in fact slightly correlated with carcass grade after the animal has been fattened. From this some have concluded that visual appraisal is something to be thrown aside as a practice completely outgrown. I don't agree with this point of view. As long as it is a method which must be used by the industry, it is a method which we should try to improve. There is no secret why our feeder grades have turned out as they have. We have been giving top grades to the small, short-legged, compact animals which we knew all the time would not make top gains and which we know now have little if any advantage from the carcass standpoint. We could easily get good correlation of weight and gain with grade by merely grading the big ones high. Of course, there is no point of doing this for we would merely be doing what the scales can do better. Certainly our present grading system for feeders can be improved for it could scarcely be worse. Probably a reasonable goal would be to develop standards which would be correlated with carcass grades and at least not opposed to rate and efficiency of gain. We should all give this some thought and it might make a good project for some ambitious young man who has more years to work it out than I have.

This brings me to one of my favorate subjects, cow production. I have been specially interested in this phase because of its almost dominant importance in our region, the wide variation between individuals, and the relatively small attention given to it. The fact that it has been neglected is shown by records taken from newly established lines in another region where feed conditions are better than our own. Their annual report contains data on 41 lines of the major breed. Three of the poorer ones were not included in this summary because of irregularities. We find the average weaning weight adjusted to 205 days (the actual was lower) to be 372 pounds. This weight would have been even lower if the bull calves had been castrated as they are in commercial herds. Only two lines produced average weights of over 400 pounds and 12 less than 350 pounds. The number of calves raised was nothing to boast about either, an average of 78.8%. If we take the actual weaning weight, 356 pounds, we find an average production of 280 pounds for each cow bred. Not very good for lines to improve commercial cattle. We might think it was because of lack of feed if these records came from New Mexico but hardly from the states involved. There is other evidence that this was not the explanation. In all states, but one, where they were all poor, there was a wide range between lines, from 452 to 306 in one case. At one station the average weaning weight for one breed was 468 pounds and 382 pounds for another. Two stations reported grade lines, in one case 414 pounds for grades and 340 pounds for purebred, in the other 465 pounds for grades and 377 pounds for purebreds. There were not enough lines of the other breeds to summarize but their weights looked quite a bit better and their calf crop poorer, in fact much poorer. This is no reflection on the stations involved. These are new lines and we can assume that some will be discarded and others improved. It does reveal a real need for research and improvement.

Some of us tend to become disillusioned when we work with carcass data. We find that grading carcasses is subject to much the same errors as judging live animals. We find that things we have considered important actually have little importance. Most of us find that we can not tell the difference between the meat from a Holstein steer and a well fed beef steer when put before us on a plate. Disconcerting as some of these things are, I think we will all agree that a high percentage of edible meat for all classes of consumers is a reasonable goal. In order to accomplish this we need a high percentage of red meat and beef with the marbling needed to make the higher grades with the minimum amount of waste fat. I have become quite interested in this point recently. It appears in most cases we have to produce more outside fat than is needed in order to obtain the marbling required for high choice and prime grades. We think we have observes significant breed and individual differences in this respect. This has more significance than appears at the first glance when it would seem to be a concern only of the butcher and consumer. Actually, it could be a matter of considerable importance in efficiency of producing this class of beef. This excess fat is put on at a high cost and cattle capable of producing the desired qualities in their carcasses without wasty fat have a major advantage in efficiency.

Any discussion of breeding plans brings up the question of cross breeding and heterosis. There is information showing that the use of bulls of big breeds increase the weight of the offspring, and bulls from poor milking breeds will sire heavier calves when bred to cows that are better milkers. Information on heterosis resulting from breed crosses is meager and somewhat contradictory. I'll admit I am at a loss to evaluate it. Such information is important in making plans, for if increases observed in certain crosses are due to introducing genes for greater production, perhaps a sounder plan would be to increase the frequency of those genes through selection. If greater production is due to heterosis, we may expect this advantage to remain, no matter how much we improve the breeds. In the latter case, we would want to retain crossbreeding permanently in our plans to obtain maximum production.

Now, I am getting on dangerous ground. I guess I should say something about the formation of lines. I think this approach to the problem is good if the purpose is to establish principles and procedures. More needs to be known about the establishment of inbred lines and their crossing and combination for best results. I would question the wisdom of establishing numerous lines with the sole hope of breeding superior cattle. Undoubtedly, excellent genetic material will come from some of these projects and that is fine, but we should hold clearly to the idea that our function is to provide facts and guidance for the industry. In this way, much more can be accomplished. Our team is just too small. A little like New Mexico A. & M. playing Texas Tech, but worse. No matter how good cattle we can produce, there will always be someone, and more than one, in this vast country who can do it better if we give them the information they are entitled to. The station worker who has the production of superior cattle as his principle goal is on dangerous ground. His facilities are too limited and his chances of success are too slim. He is much safer if he sticks to his true function as an investigator, the discovery of facts.

I know that some of you are thinking I should be embarrassed to speak this way where our kind hosts have done so much with lines of cattle. In fact, I am, a little, but I don't think I should be, for Miles City has done something more important than produce useful cattle, fine as they are. They have shown others

how to do it. Recently, I saw a small news release about a young bull with 39% inbreeding which weighed about 550 pounds at weaning and gained 3.21 pounds daily on feed. My first reaction was one of envy that I could not have produced this unusual animal. But Dr. Stonaker has done something more important. He not only has set a goal for others, he has blazed the trail to reach it. As a result, I predict many more such bulls will be produced, and not a few even better. That is what we are working for. A bull can improve a herd but an idea can change an industry. The point is illustrated by a casual remark Dr. Woodward made yesterday. He said, "You can't pay much attention to fancy points if you want to improve production." Ideas such as this can do a lot of good.

I find myself slipping further over the brink but I feel compelled to mention another subject in closing. I'll admit I do not know how important the search for superior germ plasm should be in our regional and national projects. Obviously, the task must be done by someone but it scarcely falls into the principles I have tried to outline and follow. Of one thing I am sure, if this is to be a major part of our work, we are laboring under too great a handicap if we limit our search to purebred cattle. This should not be considered an indictment of the skill of purebred breeders. They have shown a great deal of skill in developing the kind of cattle they want. I am convinced that the failure to accomplish something worthwhile more often is due to lack of proper objective than to lack of skill. My contention that much of the best genetic material may be found in grade cattle is based on three facts.

There are many more grade cattle. If we limit our search to purebreds, we would be much like a prospector who looked for gold only on the north side of the mountains leaving the other sides unexplored. Selections are made under more practical conditions and the standards of selection are more sound; freer from the fads and prejudices so hard to separate from the purebred industry; just plain observation which brings to mind the cow identified as 496. She was with us 14 of as bad years as we have ever had. She brought an early calf every year and weaned a calf way above average every year. Such cows are pure gold and the fact that their heads may be a little long or they fail to have the soft coats of hair fashion dictates is entirely beside the point. I could go on sighting such cases, but there is no need for all of you to know of them.

In closing I should say I have omitted reference to basic research in genetics and physiology because these subjects seem to fall more in the field of a long range program rather than the subject assigned to me.

Development and Testing of Inbred Lines

By Clair E. Terrill
Western Sheep Breeding Laboratory
Dubois, Idaho

It is a pleasure to meet with you to discuss mutual problems. Several of you are Collaborators of the Western Sheep Breeding Laboratory and others of you have attended our meetings at Dubois; therefore, many of my remarks will not be new to you. I particularly appreciate the opportunity to obtain your viewpoints on testing of lines. This phase of the work is fairly new in Dubois and I am sure your ideas will be helpful to us. We first crossed lines at Dubois in 1943, and last fall was the first year that line crosses were made in all of the three breeds. We still do not have an adequate line-testing program underway; therefore, much that I will say will involve plans rather than accomplishments.

There are many similarities of beef cattle and sheep. Both occupy the Western ranges in large numbers. Sheep reproduce only slightly faster than cattle and the average generation is only about one-half to one year shorter for sheep than for cattle. The replacement rate to maintain a constant number of breeding animals is essentially the same. The rate may be slightly lower for females, and slightly higher for males in cattle than in sheep. Of course, individual units are much larger for cattle than for sheep. It is generally accepted that 5 sheep equal one cow. This means, I suppose, that with equal resources your numbers of breeding cattle would be about 1/5 that for sheep. It also means that beef cattle numbers will probably be more limited than for sheep and it will be essential to use the numbers you have very efficiently.

In 1937 when we first started inbred lines on an appreciable scale we were of the opinion that we would first develop inbred lines and then 15 or more years later we would test them. Consequently, we devoted our initial resources entirely to the development of inbred lines. We started crossing Columbia lines soon, partly because we wanted information on crossing results and partly because it was an effective way of meeting the demand for sale rams. In the late 40's it became apparent that we needed crossing information in order to select among lines effectively, but that there was no room for sheep to use in crossing without culling some lines or reducing the number of sheep within each line. We were reluctant to cull lines without crossing information since information from other species indicated that poor lines on their own merit sometimes give good results in crossing. We were soon impressed with the extra resources needed to test lines if it was to be done adequately. Consequently, we now feel that the development and the testing of lines should be done simultaneously. It seems reasonable to devote as much effort to the testing of lines as is devoted to their development. Possibly only the lines which show promise in preliminary top-cross tests should be expanded and adequately tested in crosses with other lines.

It has often been observed that success in use of inbred lines of plants has followed the production of a large number of inbred lines. Then, only those giving the very best results have been used for commercial production. Certainly, we know that with the selection of individual animals our chances of success are better if we select a few from a large number. Therefore, it seems important to start large numbers of animal lines. Of course, this means that we must

start with limited numbers within each line and only the best lines from preliminary tests can be tested through extensive crossing. We also stand to lose some lines through accident or events unrelated to the merit of the line and some through poor reproduction, etc. We will be limited in the number of lines that can be maintained at one time so we need to follow a plan of continually culling the lines with less promise and replacing them with lines from new or different sources. This requires testing of lines through top crossing and line crossing as the lines are being developed.

Before discussing the testing of lines it seems desirable to present a brief outline of the method used in developing lines at Dubois. Lines have been started in each of the Rambouillet, Targhee and Columbia breeds. Efforts were made to start lines as unrelated as possible, but relationships existed between lines within breeds and in most cases between lines of the different breeds. From 1938 to about 1945 when most of our present lines were initiated, we emphasized within-line selection for overall merit. Efforts to increase the effectiveness of selection through rapid turn-over of ram generations, adjustments for environmental effects, and the use of selection indexes appeared to be successful.

We were then faced with the question of whether any gains obtained in crossing lines could be attributed to the use of inbred lines as such or to gains made from improved methods of selection. Therefore, selected, non-inbred control groups of sheep were started in Rambouillets in 1947 and in Columbias and Targhees in 1951. In estimating the gains from selection we found our results were seriously confounded by year to year environmental changes. Therefore, a genetically stabilized group of Rambouillets was added as a control for the selected non-inbred group and for the inbred lines. This group is practically non-inbred and all artificial selection is entirely at random.

We now have 27 inbred lines of Rambouillets, 18 lines of Targhees and 10 lines of Columbias. These inbred lines are composed of about 20 to 45 ewes each and generally one ram is used in each line each year. Emphasis is placed on within-line selection for over-all merit. This method has been similar for all lines until just recently. While this method may be successful in producing good lines of sheep, it does not yield any information as to whether it is better or poorer than any other method. Despite improvement in the merit of the lines themselves, it is possible that combining ability has not been improved. Also, we are running the risk that better methods might be overlooked. Therefore, a few years ago we began to diversify the ways in which lines were being developed. These ways are listed as follows:

1. Within-line selection for overall merit

This is the usual method of line formation followed in past years. It involves mild inbreeding accompanied by maximum within-line selection for overall merit. This method is being employed in ten lines of Rambouillets, 13 lines of Targhees and all 10 lines of Columbias. It is likely that other methods of forming lines will be started in Columbias after the evaluation of combining ability in the present lines is completed.

2. Recurrent selection

Development of inbred lines by recurrent selection of sires on the basis of progeny tests on ewes from another line or test flock is being tried with four lines of Rambouillets and 3 lines of Targhees. In the two pairs

of Rambouillet lines, 4 sires from each line are tested on ewes from the other line and test ewes. The best one of the four sires on the basis of his weanling offspring is used in the line the next year. In the three Targhee lines, 6 sires from each line are mated to test ewes and the best sire on the basis of his weanling offspring is used in the line the next year. The offspring of the test ewes are mated to the line sires in such a way that rams from line B are tested on offspring of line A, etc. The method is designed to provide a test group for combining ability that avoids the use of females from the lines.

3. Rapid inbreeding

Two Rambouillet lines are being inbred as rapidly as possible. This is being accomplished by selecting for inbreeding of the offspring. The sires and the dams selected are those which will give offspring with the highest inbreeding.

4. Mild inbreeding with selection at random

Two Rambouillet lines of similar size to the other lines are being inbred with selection entirely at random.

5. Mild inbreeding and selection for specific traits

One line each of Rambouillets and Targhees is being selected for body weight, and another line of each breed is being selected for type. One line of Rambouillets is being selected for clean fleece weight and another is being selected for staple length.

6. Alternative outcrossing and inbreeding

Four lines of Rambouillets are being developed by alternative outcrossing (two years) and inbreeding (four years). Two of these lines are outcrossed to outbred stock, one from Station breeding and one from outside breeding; the other two lines are outcrossed to inbred stock, one from Station and one from outside breeding.

7. Rapid formation of small lines from outside unrelated sources

Small groups of sheep (probably a young ewe with twin ram and ewe offspring) are being purchased from private breeders. Groups are selected on the basis of high merit for additive traits such as face covering, neck folds and staple length. Full-sib and sire-dam matings will be made. Where possible, the first two inbred ram offspring will be tested in crosses. In lines selected to be retained and expanded the best tested sire from the line will be used in the line as long as possible. This would insure that the relationship of the line to the tested ram would be as high as possible.

Wyoming is starting 2 of these lines, Texas at least 6, and we have 3 underway at the Station. Other states, including Utah, Nevada and California, have plans for starting small lines.

Methods of Testing Lines

The methods of testing inbred lines will depend on the ways in which these lines will be utilized and both will depend on the relative importance of general and specific combining ability. We do not have information from sheep on the relative importance of these two types of combining ability and I assume

that such information is not available for beef cattle. Therefore, it seems safest to assume that either or both may be important.

Under range conditions lines are likely to be utilized first by making top-crosses on unrelated or ordinary outbred stock and then using sires from other lines or combinations of lines in rotation. Line cross males may need to be used in both top-crosses and later in rotational crosses if the inbred males are poor in viability and fertility. The initial success of the line or line-combination will probably depend more on its general combining ability while the success of the lines used in the rotational crosses may depend more on their specific combining ability. Thus, it seems wise to test lines in both top-crosses and in various line-cross combinations.

One purpose of testing lines is to rank them on combining ability so that the better lines can be retained and the poorer lines can be discarded. A more important purpose is to determine if certain lines or combinations of lines can produce offspring superior to those which can be obtained by using selected outbred sires. Therefore, control matings with outbred sires should be made as a part of all tests to evaluate the commercial usefulness of the line tested.

Factors involved in the testing of lines, such as the number of ewes per sire, number of sires per line, number of lines per year, number of outbred sires, and number of yearly replications necessary to obtain significant differences can be approximately determined from Dickerson's theoretical studies[1]. Similar theoretical studies need to be made for cattle and sheep, taking into consideration such factors as the number of test females available at each location, reproductive rates of test females, the degree of inbreeding and relationship among lines to be tested, the age at which traits can be measured, the proportions of the offspring which can be evaluated, the heritabilities of the traits, and the previous selection within and between lines.

We have estimated that a minimum line testing plan would involve testing two sires per line for three years (not necessarily consecutive). Some measures of the variability of sires within lines and years would be obtained by using at least two sires from each line each year. The importance of yearly environmental effects and the real possibility that line-year interactions may occur indicate that tests should be made over several years. It would seem that 3 years would be a reasonable minimum.

The number of ewes which should be mated to each male each year should be carefully determined since it can vary from one to as many as 50 or more. In some of our line crosses we have mated only one or two ewes from a line to each sire from other lines. This provides (assuming a 90 percent lamb crop) an average of about 5 to 11 offspring over the three-year period for each line combination. The number would be several times greater for general combining ability of one line with several other lines. Usually the number of females which can be spared from lines to use in testing other lines is very limited. It often seems more important to obtain some information on more lines than to obtain more accurate information on less lines. With small numbers it is extremely important to adjust for environmental factors such as days growth, age of dam and sex, and to a standard number. In top-cross tests we have mated from 4 to 10 ewes per ram per year. This provides an average of from 22 to 54 top-cross offspring for each line over the three-year period.

1. Dickerson, G. E. 1942. Experimental Design for Testing Inbred Lines of Swine, Journal of Animal Science 1(4):326-341.

Ideally, the sires used to represent a line in crosses should be selected at random from the males produced in the line. The purpose of the test should be to measure the performance of the line rather than that of individual sires selected from the line. Selection of test sires at random is sometimes difficult where it is desirable to use selected males to produce inbred offspring and to produce cross progeny simultaneously. We have sometimes failed to anticipate our test crossing far enough in advance to have random samples of males available for testing. An economic factor is also involved in the maintenance of random samples of males just for line testing purposes. However, it is thought that the reliability of the test crosses for prediction of future results will be much greater if random samples of sires from the lines are used.

Crosses between Columbia lines were made in the fall of 1943 and some crossing has been done every year since then. In the first years, ewes from the larger lines were sorted at random to sires from other lines. Some reciprocal crosses were made between two or three of the larger lines. In recent years, the cross-line ewes have been distributed through the line. The present population of cross-line ewes of breeding age includes some 5-line cross ewes. Last fall two sires were used in each of the 10 Columbia lines. Each sire was mated to half of the ewes from his line (10-26), to 7 or 8 cross-line ewes, and to 3 or 4 test (top-cross) ewes. This plan will probably be followed for at least two more years.

A detailed analysis of line-crossing results is planned as soon as inbreeding coefficients of cross-line sheep can be calculated. However, some tentative conclusions concerning Columbia cross-line results are possible in spite of the lack of adjustments for inbreeding. Inbreeding coefficients for cross-lines are available only for lambs born in 1944 when it was found that cross-line lambs had an average inbreeding coefficient of 6.7 percent (because of relationship between lines) as compared with 11.8 percent for straight-line lambs.

Average results from six years' data indicate advantages of approximately 5 to 7 percent for type and condition, 3 to 5 percent for weaning weight and 1 to 2 percent for staple length of cross-line lambs over straight-line lambs. The average face covering score was similar for cross-line and straight-line lambs. Studies of lamb production showed that inbred ewes having cross-line lambs weaned 4.9 percent more lambs per ewe bred in 1944 and 1945 and 12.2 percent more in 1949 than inbred ewes having inbred lambs. The same two studies revealed that inbred ewes having cross-line lambs weaned 10.7 percent more pounds of lamb per ewe bred in 1944 and 1945 and 19.4 percent more in 1949 than inbred ewes having inbred lambs.

Adjustments for environmental factors of inbreeding may alter the results, but it seems likely that the greatest gains from line crossing were obtained in lamb production per ewe, and that improvements in type, condition, and weaning weight were rather small. There may be an additional gain from line-cross or top-cross dams. These results are in agreement with the results obtained in other classes of livestock. Of course, it is hoped that specific lines can be found which, when line crossed or top-crossed, will give greater increases over inbred lines and that these crosses will be superior to the non-inbred sheep in commercial and breeders' flocks. High relationship among present lines makes it unlikely that these aims can be achieved until new, unrelated lines are formed.

Crosses among Rambouillet lines were first made in the fall of 1949 and have been continued each year since then. In the first three years, 5 sire lines were tested. Three of these lines were among the poorest in overall merit of the 29 Rambouillet lines and were tested to determine which should be culled. The line which appeared to be lowest in combining ability was culled in the fall of 1952. Two of the five sire lines were tested because they were among the better lines in overall merit. The crossing plan followed has been to mate each of two rams from each sire line to half of the ewes from that line and to two ewes from each dam line. Six of the largest lines were chosen as dam lines and 20 ewes from each line were used in crossing in 1949 and 1950. In 1951, one line had to be removed from crossing because of insufficient ewes and only 10 ewes were available from each of two other dam lines. A few reciprocal crosses were made with ewes from two of the sire lines. In 1952, a new cycle of crossing was started in which one sire line was repeated and 4 new sire lines were included. Three of the original dam lines were repeated and two new dam lines were added.

In 1953, cross-line Rambouillet lambs appeared to excel straight-line lambs in every trait except neck folds and showed an approximate advantage of 1.7 percent over straight-lines in overall merit. However, the cross-line lambs excelled over the lambs from the selected control group only in weaning weight and condition. The control lambs showed an advantage of 4.2 percent over the cross-line lambs in overall merit. The control group excelled in the highly heritable traits like face covering, staple length and neck folds. It appears that progress from selection for such traits is greater in non-inbred than in inbred groups.

In summary, we believe that an adequate line-testing program should start early in the development of lines and should include both line-cross and top-cross tests. Males should be selected at random from the lines to be tested. More than one male should be used from a line and the minimum should be 2 for each year and location. Tests should be repeated in at least 3 different years. Two to 4 offspring per sire per year for each line-cross or top-cross combination may be sufficient and certainly little would be gained by increasing this number beyond 8 to 10. Outbred control sires should be included each year. Some reciprocal crosses are advisable. It seems desirable to stagger the testing of lines so that not all of the lines tested are changed in successive years.

Line Testing Using a Test Herd

By R. R. Woodward
U. S. Range Livestock Experiment Station
Miles City, Montana

As near as we can determine, we are achieving some success in selecting for the factors on which we are placing most of our emphasis, namely, gaining ability, milk production, and conformation. Giving an objective analysis of what has happened to conformation, thickness of fleshing, carcass quality, and other similar characteristics, is a bit difficult since our guide must be visual appraisal.

I want to briefly discuss the testing of the various lines for combining ability. We have been making cross-line matings during the past 10 years. These line crosses are evaluated on the basis of gaining ability, milk production, conformation, and fertility. We found 12 of the cross-lines were intermediate to both parental lines. Three were inferior and three superior to the parental lines. For the most part we were not able to observe a very high degree of heterosis in the cross-line matings to date. We have encountered some problems in our cross-line matings, the most important of which is numbers of animals. In order to make cross-line matings we have had to divert a portion of the herd from the regular line breeding program to the cross-line matings. Line 1 has, in a sense, been our tester line for the other lines at the station. In order to accomplish this, two additional sub-lines from Line 1 have been diverted to cross-line matings. It was necessary to relax the culling level for Line 1 females in order to supply the necessary replacement heifers for the new sub-lines. It can readily be seen that this procedure can make quite a difference in the improvement within Line 1.

Cooperative Line Testing

By Carl B. Roubicek
Western Regional Coordinator
Denver Colorado

Cooperative line testing, as I understand it, involves (1) between-station line testing or (2) a central testing station. I think the problems involved in these two operations are very similar and can be discussed together. First of all, there is the item of cost which at first glance makes these plans appear almost prohibitive. A central testing station would require new land or having an existing station devote their entire facilities to this work. It would also mean establishment of a tester cow herd and the necessary personnel to properly handle the work. Even the cost of shipping bulls to a central or cooperating station is no small item. Artificial insemination may be an answer to part of the difficulty, yet we all know the problems involved in an artificial insemination program.

These two methods of line testing do not provide a method f or the evaluation of cows in the lines. If, for example, a female fertility problem is present in the line being tested, there is no method provided for proper determination of this characteristic in over-all line evaluation. A method for evaluating line bulls from top-cross performance could even be controversial. The economic importance of the various performance characteristics would likely be different in Arizona or New Mexico than in Idaho or Montana.

There are, however, some desirable features of this cooperative testing which may offset the difficulties of cost and management. We would have much more information on the value of many of our lines. It would provide a rapid and accurate means of determining year and environmental interactions as well as heritability estimates.

Since the development of inbred lines is an important part of our overall program, it will be necessary for this group to come to some understanding as to the most feasible plan for line evaluation. Within the next two years we should develop a plan that we will support and make the necessary arrangements to implement the plan.

Line Evaluation by Recurrent Selection

By A. E. Flower
Montana State College
Bozeman, Montana

While our line testing work at Havre is directed toward investigating a special type of recurrent selection combined with record of performance procedures in nominating bulls to reproduce their own lines, we have had some experience which should be valuable in future line-testing planning.

First, we have found that a grade tester line can be maintained to test 2 bulls each from three lines of purebred Hereford cattle at Havre without depleting the numbers of females in the tester line of approximately 80 cows, 3 years old and over. About half the females are required to test the 3 lines, and the remainder are bred to bulls of the tester line to provide replacements in that herd. Numbers are materially increased for testing by breeding yearling heifers. This has given us little calving difficulty under our North Montana environment.

We have found that a bull can be (1) screened by record of performance feeding (2) progeny tested in cross-line mating, both as to feeding performance and carcass characteristics of his steer offspring by the time he has reached 3 years of age. He can thus be used to reproduce his line in this program as a three-year-old, with a thorough test record behind him. Cow numbers allotted to test herds have been no less than 12. Perhaps greater efficiency would follow if we used even fewer.

As far as we know, our station is the first in the United States to actually use progeny carcass data as one consideration in choosing a sire for service in his line.

It is my thought (probably not original w ith me) that our U. S. Department of Agriculture Beef Cattle Breeding scientists and facilities might well move in the direction of more line testing and less in the actual formation of lines, since testing procedures are more complex and involve more complicated statistical evaluation than do the production of lines. This seems more in line with the abilities of our highly trained U. S. Department of Agriculture personnel.

It is not to be inferred that we consider the testing procedure used at Havre to be an unbiased sampling of the combining ability of our Havre lines. What we do feel is a contribution to regional know-how in line testing, however, is that we have developed a workable system of testing a moderate number of bulls per year without reducing selection pressure in any purebred line, since our test herd are grade animals repeatedly top-crossed to Miles City Line 1 males and do not in any way affect progress in that line.

9b3 Allotments
W-1

Station	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	Total to 6/30/54	Proposed 1954-55	Total to 6/30/55
Arizona	1,600	2,600	2,500	2,500	2,500	2,500	14,200	4,000	18,200
California	---	---	---	3,000	3,000	4,600	10,600	5,500	16,100
Colorado	2,400	8,650	8,550	8,300	8,300	8,000	44,200	9,000	53,200
Hawaii	---	---	---	---	---	3,000	3,000	4,500	7,500
Idaho	---	5,250	5,150	5,000	5,000	5,000	25,400	6,000	31,400
Montana	1,800	4,700	4,600	5,000	5,000	5,800	26,900	7,000	33,900
Nevada	---	3,100	3,000	3,400	3,400	3,900	16,800	5,500	22,300
New Mexico	1,600	9,400	9,300	9,000	9,000	8,000	46,300	9,000	55,300
Oregon	1,600	9,300	9,200	8,900	8,900	8,000	45,900	9,000	54,900
Utah	1,570	8,550	8,450	7,690	7,690	5,500	39,450	7,000	46,450
Washington	1,200	6,850	6,750	6,140	6,140	5,000	32,080	6,000	38,080
Wyoming	---	3,100	3,000	3,500	3,500	6,700	19,800	7,500	27,300
P & C	1,424	1,500	1,461	1,570	1,570	2,000	9,525	2,000	11,525
Totals	13,194	63,000	61,961	64,000	64,000	68,000	334,155	82,000	416,155

ARS FUNDS - W-1

Station	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	Total to 6/30/54	Proposed 1954-55	Total to 6/30/55
Arizona	---	1,800	1,800	1,800	1,800	1,800	1,800	10,800	1,800	12,600
California	---	2,800	2,800	2,800	2,800	2,800	3,230	17,230	3,230	20,460
Colorado	3,034	3,400	3,400	3,400	2,525	3,200	2,700	21,659	2,700	24,359
Hawaii	---	---	---	---	---	---	---	---	---	---
Idaho	---	---	---	---	---	---	---	---	---	---
Montana	800	2,400	2,400	2,400	1,100	2,400	2,300	13,800	2,300	16,100
Nevada	---	---	2,000	2,000	666	---	---	4,666	---	4,666
New Mexico	2,580	3,960	3,960	3,960	3,960	3,800	3,200	25,420	3,200	28,620
Oregon	4,073	4,800	4,800	4,800	4,800	3,600	3,600	30,473	3,600	34,073
Utah	1,766	2,400	2,400	2,400	2,400	2,400	2,400	16,166	2,400	18,566
Washington	2,100	3,000	3,000	3,000	3,000	2,400	---	16,500	---	16,500
Wyoming	---	---	---	---	---	---	2,550	2,550	2,550	5,100
Totals	14,353	24,560	26,560	26,560	23,051	22,400	21,780	159,264	21,780	181,044

Total ARS & 9b3 Funds - W-1

Station	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	Total to 6/30/54	Proposed 1954-55	Total to 6/30/55
Arizona	---	3,400	4,400	4,300	4,300	4,300	4,300	25,000	5,900	30,800
California	---	2,800	2,800	2,800	5,800	5,800	7,830	27,830	8,730	36,560
Colorado	3,034	5,800	12,050	11,950	10,825	11,500	10,700	65,859	11,700	77,559
Hawaii	---	---	---	---	---	---	3,000	3,000	4,500	7,500
Idaho	---	---	5,250	5,150	5,000	5,000	5,000	25,400	6,000	31,400
Montana	800	4,200	7,100	7,000	6,100	7,400	8,100	40,700	9,300	50,000
Nevada	---	---	5,100	5,000	4,066	3,400	3,900	21,466	5,500	26,966
New Mexico	2,580	5,560	13,360	13,260	12,960	12,800	11,200	71,720	12,200	83,920
Oregon	4,073	6,400	14,100	14,000	13,700	12,500	11,600	76,373	12,600	88,973
Utah	1,766	3,970	10,950	10,850	10,090	10,090	7,900	55,616	9,400	65,016
Washington	2,100	4,200	9,850	9,750	9,140	8,540	5,000	48,580	6,000	54,580
Wyoming	---	---	3,100	3,000	3,500	3,500	9,250	22,350	10,050	32,400
Totals	14,353	36,330	88,060	87,060	85,481	82,830	87,780	493,894	101,780	585,674

Some research accomplishments of the national beef cattle breeding research program, presented by Dr. R. T. Clark, National Coordinator, at Washington, D. C., April 12-15, 1954, and at Miles City, Montana, July 7-8, 1954.

Introduction

A review of accomplishments would not be complete without reference to the men such as the late Director F. B. Linfield, Dr. E. W. Sheets, and Superintendent J. R. Quesenberry, who is with us today, who in the middle twenties had vision enough to take on a venture like the U. S. Range Livestock Experiment Station (Fort Keogh), Miles City, Montana. The program which we review today was largely stimulated and developed from the work of this station and related pioneer work conducted on a smaller scale at other stations.

Our cattle program is a decentralized type of effort. No laboratory as such was ever established. The Regional Swine, Poultry, Sheep and Disease Laboratories utilized all the funds for such purposes under the Bankhead-Jones Act. Therefore, laboratories for either beef or dairy cattle were not established under that initial Regional Laboratory legislation.

The project title, "Improvement of Beef Cattle Through the Application of Breeding Methods," identifies the majority of the approved projects, although methods of approach a nd design are influenced by subject matter variation within and between regions due to environmental requirements, availability of state and federal financial support, research facilities, and technical personnel.

Research manuscripts and reports from the inception of the projects to date (April 12, 1954) as reported by the three Regional Coordinators are given in the following table:

Publications by Regions

Region	Project Initiated Under R. & M. Act	Number of Publications
NC-1	July 1947	34
S-10	March 1948	36
W-1	July 1947	116
	Total	186

(Dr. Roubicek informs me that as of July 7, 1954, W-1 has produced 148 publications. We have been informally advised that this is the largest publication output of any R. & M. Act regional project).

Some Accomplishments of Note

(1) Various objective components, including birth a nd weaning weight and feed-lot gain, have proved superior to visual selection as beef cattle improvement tools.

(2) The existence of a high variability in rate of gain has been noted in connection with a large number of performance tests with beef cattle at different stations. Refinements in R.O.P. procedure have been accomplished through the use of pelleted rations.

(3) Heritability estimates have been determined for a number of characteristics such as birth weight, weaning weight, weaning score, gain (birth to weaning), gain on test, efficiency of test gain, eighteen-month weight, eighteen-month score, calving interval, intensity of color, etc.

(4) Unpublished results for a ten-year period on time-constant feeding trials at the Miles City station indicate that growth after weaning (on R.O.P. test) and efficiency of gain were significantly correlated. Birth weight was related to subsequent growth more highly than was weaning weight. Both factors were positively associated with carcass quality. Final weight and average daily gain were positively correlated with most of the desirable carcass characteristics.

(5) At New Mexico and Montana, gain on the range has been found to be correlated with gain in the feed-lot. At Virginia, general agreement of correlations within sires and between feed-lot and pasture performance indicates that progeny tests with either dry-lot or pasture feeding can be used to identify sires that transmit ability to make rapid gains.

(6) Preliminary analysis of cow-and-calf data in the Southern region confirms results previously secured at western stations, that weaning weights of calves increase with the age of the dam until maturity is reached at 6 to 8 years. Therefore, a number of stations have developed correction factors for age of dam, sex of animal, coefficient of inbreeding, etc. Repeatability of weaning weights of calves from the same cow is usually in the range of .4 to .5, thus being high enough to permit fairly early culling of cows.

(7) In milk production studies with beef cows at Arkansas, high-producing cows tend to produce the largest calves at weaning. Eight-month calf weights had a positive correlation of 0.47 with milk records.

(8) Results from feeding trials conducted at the Ohio and Texas stations indicate that bull calves produce larger and more efficient gains than steers and gave satisfactory carcasses, but sold at a discount on the open market. The practice provides an effective means of widening the genetic base in the selection of future herd sires, and financial loss can be minimized by selling on a carcass grade and yield base.

(9) Comparative performance of Brahman crossbreds and British breeds of cattle indicates that weaning weights of calves were increased by 28 pounds where Brahman bulls were used on British type cows and by 83 pounds when British bulls were used on Brahman crossbred cows, as compared to straight bred British stock. Crossbred calves have been equal to British type calves in feed-lot performance and percentage of wholesale carcass cuts, and have excelled in carcass yield.

(10) Blood-typing technique has proved to be a satisfactory means of determining non-parentage in beef cattle and large numbers of cattle have been typed (Colorado, Wyoming, Montana, and California stations). In addition,

the blood antigen frequency is being studied in relation to computed inbreeding and to determine if an association exists between blood group and some factor of individual performance.

(11) The Oregon station reports a significant increase in rate of gain and feed-lot efficiency due to controlled injections of the male hormone, testosterone.

(12) The serum protein bound iodine levels have been investigated at the Texas station with large numbers of beef calves and results indicate that calves which show a wide variation in protein bound iodine also exhibit a wide variation in rate of gain.

(13) Dwarfism research was conducted at several stations in the Western and other regions to determine modes of inheritance and methods of identification and control. The California station reports the profilometer technique to be highly accurate in the identification of carriers of the dwarf gene in mature horned Hereford bulls. Other methods of identification are being investigated. The California station has assembled the most extensive herd representing all breeds and is currently in the strongest position among stations to study the mode of inheritance of the various forms of dwarfism and thereby add to basic information on this genetic problem. (At the height of all the controversy on the profilometer technique and while Gregory had been provided a haven in which he could operate freely and spend his sabbatical leave working in Denver, he told us it might be a good idea if research people returned to the old system of publication. An investigator would leave all of his notes and manuscripts to a friend who would proceed with publication of the findings only after the death of the investigator, thereby saving him all the agony from carping critics.)

(14) Breeders are becoming acutely conscious of a need for weight-for-age information in young breeding stock, and crossbreeding information, as well as for the identification of certain deleterious heritable characteristics in beef cattle, including dwarfism.

An indirect accomplishment stemming from this and other programs is the influence that we have brought to bear on Animal Husbandry Departments throughout the nation causing them to re-evaluate visual appraisal techniques. The critical appraisal by stations of "watch charm" (comprest) and "middle-of-the-road" cattle that judges have been putting up in shows has brought about more constructive reasoning on type relationships. The commercial man complains he cannot make money on these cattle and is refusing to take them.

Future Course of the Program (and Problems)

(1) Continued emphasis on analysis of data and publications is necessary. It is easy to discern where and why we are getting the manuscript production in certain areas and states.

a. The beef cattle industry is a major enterprise concerning all stations in the West. This has long been recognized by the Directors of the Western Region, as evidenced by their strong support to W-1.

b. We get the most production from financial inputs into stations where either of two important characteristics are present:

1. A state staff with enough salary money going into the project to hire a professional staff and sufficient graduate students.

2. An adequate full-time federal staff devoting all of its activities to the work.

In some areas and states we have real problems in data analysis. Some are just not producing and as at present constituted may not in the near future, unless careful attention is given to this problem by the subject matter personnel involved, including the coordinators. I have kept this problem in the foreground at every opportunity, for it is a vital part of the program. Data analysis performed currently and used currently will determine our rate of progress. Semi-extension work, while important, should always take a back seat to data analysis. I find it hard to get some people to realize that we must produce useful research publications in adequate volume or our project will retrogress.

In this connection, by cooperating with other agencies of government at Denver, we have been able to utilize the most up-to-date equipment that is available anywhere in our country and at low cost to our own agency. All of our effort so far has been financed out of savings in our budget wherever we could make them in items for travel, unused salaries, etc. No direct funds have ever been provided for this badly needed work. Through this means we now have all of the Miles City station data back to 1926 in proper form for speedy analysis. We intend to keep that station at least on a current basis and hope by example to encourage others, especially our federal stations, to cooperate with us. We have found some experimental workers, both in and out of government, very slow to realize the labor savings and efficiency in output that can be achieved by using the newest methods of analysis.

Under the general heading of data, there is need for clarification of current agreements where any ambiguity exists as to equal access to data by state and federal workers where financial inputs are being made into specific projects by both parties. The older agreements prior to the Research & Marketing Act were, in the opinion of workers concerned, much more specific in outlining equal access to data and thereby establishing joint interest in getting data processed, published and used. A few states feel that the federal government is only a silent partner and should not be concerned with anything else than distribution of federal funds.

By contrast a number of states, notably Texas, furnish data to us in its original form with no questions asked whether we put money directly into the project or not.

(2) Record of Performance programs will be expanded and refined. In view of the increasing interest in performance testing, notably on the part of commercial cattlemen and a limited number of registered breeders, we have long believed and frequently recommended that the Department should push performance testing from the Extension side as well as Research. Hence, our reason for advancing parallel proposals under

Extension for they should be integrated. The Federal Extension Service working with state specialists could be very effective in establishing sound improvement and selection practices throughout the industry. Only a few states have effective programs of this kind.

In regard to Research, I believe we should establish at Denver a Beef Cattle Performance Testing Laboratory which would study present performance tests, recommend improvements, and establish the relative merits of each individual animal. Such a laboratory would be a statistical unit designed to increase the accuracy with which the data gathered truly determine the genetic and economic worth of the animal. The laboratory would start with existing published material and current tests, but in addition would draw on standard tests to be made on top stocks which would be maintained at Beef Cattle Selection Stations. Such stations should be concerned with the maintenance and improvement of sources of top breeding stock suitable for the needs of the region they serve. They would perform the standard tests by agreement with the Testing Laboratory and maintain the closed lines and populations as the Testing Laboratory may need to measure the success of the selection program. Wherever facilities permit, these stations should also test breeding stock for private owners. They may be authorized to issue Certificates of Performance which would be recognized by breed associations.

With respect to refinement of Record of Performance procedures, we should continue to study anatomical, physiological, and genetic bases of relative performance in an attempt to find methods of classifying animals into their relative performance groups at an early age. We should also encourage continuation of the basic work on live animal appraisal, of which the anti-pyrene test is an example.

(3) In view of existing variation, it is apparent that an active and expanded program of sampling within present breeds will pay off. Wherever possible, we should capitalize on current testing programs, of which PanTech Farms, Amarillo, Texas, is an outstanding example, or cooperative field testing programs conducted by state Extension Services, of which California and Washington are notable examples. I am reminded of a recent observation by a state worker in the North Central region who told me, "Until I got into this program I didn't realize there was so much trash in the British breeds."

(4) In spite of all the lines which we have started under this program to date, very few adequate tests have been made to assess these lines, either in top cross or cross line systems. A few of these cross line tests have shown sufficient promise to warrant fully expanding this phase and to encourage early testing. The possibility of using a central testing station such as Fort Robinson or Fort Reno should be considered. This was in our original planning when Fort Robinson was transferred.

We are also interested in determining the interaction of genotype and environment on performance factors and wherever possible should expand the testing of lines at different stations from those where the lines were developed. The Oregon station may be the first to give this a real trial.

(5) I have observed a real need for, and have for years repeatedly recommended, the establishment of a sound national program that would cover the introduction of all classes of animals. Such an introduction program should contemplatethe introduction of animals (a) within breeds now present in the United States, and (b) within breeds and types that have never been used in the United States.

Such a program would permit access to all available material wherever located and is in the best interests of our country just as much as the national plant introduction program has through the years permitted opportunity for improvement within the plant field.

I recommend, therefore, the setting up of animal introduction or exploration specialists who would seek and obtain material from other countries worthy of testing under specific environments within our own boundaries. This may seem like rank heresy, but some people have felt that we could perhaps make the greatest progress toward the breeding of productive beef cattle if we were to use genetic material drawn from the work oxen types which still exist in certain parts of the world, for in super-refinement of the British breeds we may have gone overboard on quality and lost out on the all-important factors governing growth and efficiency of output.

(6) Research on the physiology and reproduction of beef cattle has had to stay in abeyance during the formative stages of the breeding project. This is to be regretted and represents an area where our program is vulnerable. Dr. Roubicek has repeatedly pointed out how vital percentage calf crop is as affecting profit. We would like to initiate studies (a) to determine genetic and environmental causes of infertility, (b) to accurately measure fertility, and (c) to develop an early pregnancy diagnosis test.

In addition, it is high time that we develop sound methods of applying artificial insemination techniques to beef cattle. Currently, we are using far too many average or below average bulls with respect to beef production, thereby retarding progress in commercial herds.

Research on applying artificial insemination to beef cattle would more than pay its way if procedures could be worked out to fully utilize top producing bulls. With impending changes in semen storage, a whole new era has opened up which could completely alter the registered cattle business and lead to the most rapid progress ever attained.

(7) For a long time our major breeds have been carrying along a number of deleterious characteristics. Secrecy bordering on absurdity has prevailed among registered breeders until recent times, when one character--dwarfism--got so far out of hand that a number of us, realizing the seriousness of the situation, started to w ork with a few key breeders. To these men we owe a great deal, for they have opened their records to us. We have all been castigated for trying to perform a service, but little did we realize how some of those key breeders would be impugned and pressured. The key station in this early work was, and still is, the University of California.

We would like to expand this work to include all deleterious characteristics of beef cattle, and feel that our work should include not only techniques for elimination but also basic information on mode of inheritance of the characters studied.